THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
The Miners' Minimum Wage	889
London Railway Electrification	890
The Burdens of the German Manufacturer	891
Electrical Accidents in Mines	891
Kjellberg Electric Welding System (*illus.*)	892
Ironmongers and the Sale of Electric Lamps	892
A Novel Country House Installation (*illus.*)	893
Two-Wattmeter Method of Measuring Power in Three-Phase Circuits (*illus.*)	895
Correspondence :—	
A Reliable Rectifier Wanted	895
Operators in Electric Theatres	896
Electricity in Mines	896
The Cash Value of Electrical Knowledge	896
The Subtractive Production of Artificial Daylight (*illus.*) ...	896
Legal	897
New Electrical Devices, Fittings and Plant (*illus.*)	898
Business Notes	900
Bulk Supply at Turton, Lancs. (*illus.*)	907
Electricity Supply in Bridgetown, Barbados (*illus.*)	909
The Gyro Compass (*illus.*)...	910
Notes	912
City Notes	914
Electric Tramway and Railway Traffic Returns	918
Stocks and Shares	918
Share List of Electrical Companies	919
Proceedings of Institutions :—	
Graphite as a Lubricant	921
The Mechanical Design of Direct-Current Turbo-Generators (*illus.*)	921
Modern High-Voltage Power Transformers (Discussion)...	924
The Institution of Electrical Engineers	924
Silvertown Train Lighting System (*illus.*)	926
New Patents Applied For, 1911	928
Abstracts of Published Specifications	928
Contractors' Column ... ... Advertisement pages xxiv and xxvi	

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THE MINERS' MINIMUM WAGE.

THE Miners' Federation of Great Britain duly held their adjourned meeting on the 14th ult., but, we are glad to say, did not carry out their foolish threat to call a national strike to enforce the impossible demands of ignorant and ill-advised miners, and, in fact, there now seems every reason to think—though the situation is still more or less critical—that the wiser counsels of the more reasonable section of the men's leaders will prevail over those imbued with the belief that, as coal cannot be dispensed with, the miners have only to refuse to work to obtain any terms they care to impose. At any rate, there is now no possibility of a strike at Christmastide, as the next meeting of the Miners' Federation does not take place until December 20th.

Previously to the last meeting, the owners again met the miners' representatives, when the latter proposed a minimum wage of 7s. per day, but the owners definitely stated that they could not agree to it. On the other hand, they (the owners) approached the matter in a very conciliatory spirit, and a provisional agreement was made between the parties fixing the wages of boys and day-wage men; the owners further offered to continue the negotiations with regard to the "abnormal place" question, with the object of giving each district an opportunity of devising means to regulate the additions to be made to the tonnage rate of a miner working in an abnormal place where the conditions are such that he cannot honestly earn a fair day's wage. Beyond this the owners cannot possibly go, and many think that to go so far is unwise—even in face of the threat of a national strike. In fact, many people intimately connected with the coal trade think that a strike would not be altogether an evil, as it would tend to clear the air and teach the miners a lesson which would settle matters for at least some time to come. As things are, the more militant section may look upon this concession as fear, on the part of the owners, of a strike, and the introduction of machinery for regulating the wages in abnormal places as the thin edge of the wedge towards the greater demand of a minimum wage all round. It is sincerely to be hoped, however, that the owners will remain firm against the latter demand, and will also carefully guard the proposed new machinery against any possible interpretation of its being applied to any working place other than the purely "abnormal." The real difficulty lies in the determination of what is an "abnormal" place, as it has been proved over and over again that one man will be able to earn good wages whereas another in the same place cannot do so, and the latter because of this will complain that it is "abnormal." The difficulty will thus readily be appreciated even by those who know nothing of coal mining. Who is to decide the question? A committee of miners' representatives, consisting for the

most part of inefficient workmen?—Be it noted, the good workman, capable of earning good wages, is as a rule satisfied with his lot, and even has very little sympathy with his grumbling, dissatisfied mates; but unfortunately such men take very little interest in the doings of the union, or we should undoubtedly hear less of complaints and threats to strike. But to return to our question; if, as is probable, a committee or board of inspection be formed, and on the men's side there are poor workmen filled with the idea of an 8s. daily wage minimum, it is most likely they will decide in every case that the place in question is "abnormal," and as there will also be certain fees paid by the union to the men making the inspection, one can easily foresee a most harassing time for the colliery manager and his owner, as undoubtedly as fast as one place is agreed upon as "abnormal" another will arise, and an "inspection" job will always be very much preferred to that of doing a day's work at the "face."

The fact is that during the past few years the owners have been much too generous, and have granted far too many concessions; and this, together with the ill-effect produced by the spouting of Socialist malcontents with an eye to a soft job in the union, has so filled the miner with a sense of his own importance, that he thinks he holds the key to lock or unlock—as he thinks fit—the door of the world's industry. He overlooks the fact that he is merely a labourer—a more or less skilled one we admit, but only of a second or third-rate class—and as such can only demand the wages of such class, for immediately wages go up in the coal trade, as they did, for instance, about 1901, men leave other occupations, especially sailors, farm hands, and such like, for work in the pits. It is true that a man must serve a sort of apprenticeship for a period of two years before he can become a fully-fledged coal hewer—the autocrat of the pit, as someone facetiously but aptly termed him—but this does not deter them. Considering the number of hours worked, the miner is one of the highest paid workmen in the country, but as all piece-work shows, whether in an engineering shop or at a coal-face, there is a great difference in men, and where one cannot earn a living another will do well.

As regards the profits from coal mining, it is an admitted fact that these only yield about 5 per cent., yet the leaders of the men—Mr. Straker, for instance, of the Northumberland Miners—are inflating the workers with ideas of huge profits being made by coal owners. In a recent speech, Mr. Straker said that coal hewers had not the necessaries of life, while owners were becoming millionaires, yet as we write we have before us a report of the annual meeting of the Horden Collieries, Ltd., where Sir Hugh Bell told the shareholders that the company had been registered for 11 years and 8 months, during 5½ of which years they did nothing but *spend* money, and now all they had to offer was a mere 4 per cent. This is not an old colliery, but one of the largest and newest in the county, replete with every modern improvement. But how many collieries are paying no dividend at all, and how many more are struggling on, though losing money, in the hope of better times coming? One colliery lost £20,000 in three months after the introduction of the Eight Hours Act, and had to be closed down. Mr. Straker, however, carefully avoids any reference to these cases, though he must be aware of them; instead, he would like to know the individual profits of coal owners, which information naturally is withheld, but he has no more right to assume because of this that owners are pocketing huge profits than we have to take the 10s. and 15s. per day to coal hewers as fair examples of the wages of miners. We know that some coal owners are doing well, as we know that some coal hewers are earning exceptionally good wages, but no industry can be regulated as regards wages by taking the lowest wages and highest profits of individuals as Mr. Straker wishes to do.

To sum up the position as it stands at present, we have the men in Northumberland and Durham—the latter county at present taking a ballot vote against the three-shift system—and South Wales clamouring for a national strike, while the men in the other federated areas, excepting perhaps Derbyshire, are more or less contented, while the owners are doing everything possible to meet the demands in order to avoid a national calamity. A meeting of owners and men's representatives is again to take place on December 6th, and a further meeting of the Miners' Federation on December 20th, and on these two meetings depends the issue. Whether it will be war or peace none can say, but as we have already said, many would welcome the former as probably being the evil which would produce most good. Meantime we repeat our warning to all depending upon a coal supply to watch and be prepared as far as they possibly can.

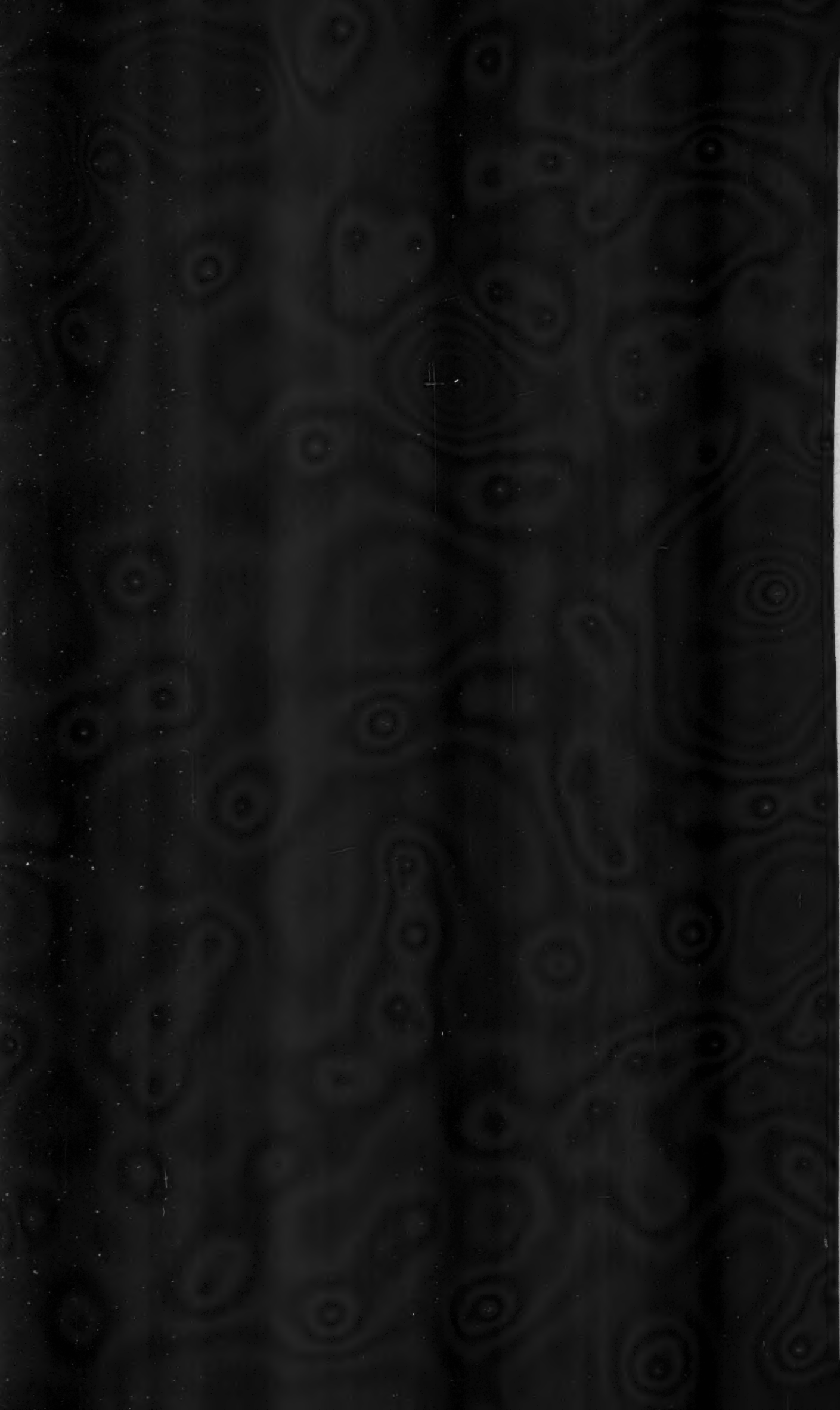
London Railway Electrification.

From time to time it has been our wont to criticise the laggard attitude of the more important English railways in the matter of railway electrification, and one only need look over the astonishing crop of electric railway proposals for London, which made its appearance so suddenly last week, to realise what scope there is for local electric railway working.

The various proposals touch the North, East and West of the metropolis—on the South side, apparently, no further development beyond the work already carried out by the Brighton Co. is to be looked for yet, as the South-Western Co. are absorbed in the work of reconstructing Waterloo Station to the exclusion of other matters, and the South-Eastern and Chatham Co., judging by official utterances, are determined to live up to their reputation for chronic indifference to traffic working, which results from crowded terminal stations and lines.

Of the new proposals put forward, that of the North-Western Co., for the electrical working of its own line between Euston and Watford, and the leased lines of the North London Co., between Broad Street and Kew Bridge Station—through which, of course, the District Co.'s electric trains now run to Richmond—is a most comprehensive one, embracing some 40 miles of route. Possibly the most interesting feature of the above scheme, the cost of which it is understood will fall on the North-Western Co.'s shoulders, is a proposal to construct a short connecting tube line between Queen's Park and the Paddington terminus of the Bakerloo tube railway, and to run tube trains from the South London terminus of that line to Watford. Apparently no constructional difficulties are anticipated in connection with the joint rolling stock; at any rate, the North-Western Co. has taken up a very different attitude to that which resulted in the expensively large tube of the Great Northern and City Co. and its full-size rolling stock being adopted.

The scheme marks the first real attempt of the North-Western Co. to cater adequately for the suburban passenger, and it avoids the costly tube railway from Kilburn to an



underground station at Euston, originally included in the company's 1907 proposals.

Curiously enough, the announcement of the North-Western's Watford scheme was immediately followed by one on the part of the Metropolitan Co., which proposes to build a branch line to that place, and to extend its electrically worked services there also.

Yet another proposal, that of the Central London Co., which is already engaged on extensions which will link up Liverpool Street with Ealing through its tube line, is to build a loop line through Chiswick, Kew, Hounslow, &c., to the new Ealing line; and this does not exhaust the list, for the East London electrification will shortly be under way, and the District Co. is busily engaged in doubling tracks wherever possible with a view to still further augmenting the wonderfully frequent services which it now gives.

We have refrained from mentioning the Brighton Co.'s further electrical projects, which are understood to be of a comprehensive character, and the ultimate destiny of the Tilbury line, in the event of the Midland Co. taking over that concern, is probably bound up with electrification.

While it is, of course, somewhat idle to speculate on the prospects of these various projects at the present stage, it is useless for the most ardent steam traction enthusiast to deny their far-reaching character or the inference which may be drawn from them. The lessons of the District, Metropolitan, South London and other electrified lines are at last bearing fruit, but it is astonishing that, in the case of existing railways, it should be necessary for the latter to be on the verge of collapse before the owners can be brought to see the expediency of spending money on a good thing. Obstacles there are always in the way of financial railway proposals, but it is difficult to understand why productive expenditure on electrification meets with such determined opposition on the part of the older railway companies, that it may generally be said that they only adopt electrical working under compulsion.

It is this aspect of the matter which strikes one most forcibly—nothing less than disastrous competition on the part of tramways, 'buses, or other electrically worked lines, will, as a rule, influence the English railway director, although there is another aspect of electrification, even more important than its ability to meet competition, and that is, the opportunity which it gives of relieving the ever-increasing congestion of existing terminal approaches and stations, even with a more frequent service of trains than may be accommodated under steam working.

To realise how important the question of terminal accommodation may be in London, one only needs, for instance, to use habitually the London Bridge stations of the Brighton and South-Eastern Companies; at a moderate estimate, nine-tenths of the steam trains entering these stations are some minutes late under normal conditions, and the merest hint of other than normal conditions renders their working chaotic in the extreme.

We are entirely in agreement with a writer in one of the financial papers, who says that "Electrification within a radius of, say, 25 miles from a great London terminus represents . . . . the only means whereby it is possible both to reduce terminal congestion at a minimum outlay and to make that outlay productive of new business." The North-Western Co.'s scheme is important in that the company appears to have fully realised the fact.

The question of terminal congestion due to suburban traffic appears to be the crux of the whole situation; practically all the great railways, except those which have elected to extend their London terminal accommodation at enormous expense, must shortly face the situation, and meanwhile the suburban passenger must presumably put up with the callous disregard which, in too many instances, has been his portion for years, and which, it is not too much to say, has driven him to the electric tramways for suburban journeys of up to 6 miles or so.

The tramways are within easy reach of the majority, the services are frequent and involve little waiting about; they are also cheap, and in the end do offer a quicker means of transit for a short journey, than many of the infrequent, unpunctual, crawling, stopping trains which some companies appear to regard as "an excellent suburban service."

The Burdens of the German Manufacturer.

A REPORT presented to one of the principal German Associations of Engineers (the Machine Makers), and referred to in an engineering contemporary, dwells upon the increasing difficulties which the German engineering industry has to face, and shows pretty clearly that on the other side of the North Sea the stress of competition is at least no less keenly felt than here. Employment was in July reduced by 4 per cent. as compared with the previous two years, which were, however, exceptionally busy ones.

The actual dividends earned by the various engineering concerns reported upon must be considered very good, the average earnings for textile machinery being 13 per cent. in 1910, agricultural machinery 9·5 per cent., locomotives 9·4 per cent., and for general machinery 5·1 per cent.

Complaint is made of the long credits that have to be given, especially in the foreign trade, and of the manner in which such credits are extended by the customer on various pretexts, which results in a large part of the manufacturers' profit going to pay interest on bank overdrafts.

The main difference in this country is that the banks here are not nearly so ready to assist the manufacturer as the German banks are, which gives the Germans a very great advantage in the getting and carrying-out of orders.

A British Consular report from Leipzig bears out the above account and draws attention to the efforts, sustained, systematic, and highly effective, adopted by our German rivals in South America, Russia, and in practically all the British colonies and dependencies.

The old story is repeated. Longer credit is given and closer attention is paid to the requirements of the customer. Immense importance is attached to the foreign trade; and no pains are spared to gain and keep a good position in each importing country, whether by Government officials, association of traders, or individual firms.

Nevertheless the increased cost of living, the rise in wages and other growing burdens of manufacturing, are beginning to tell; and competition is being daily felt to be more severe. We venture to add, on our own account, that the handicap against the German on account of his import duties is probably well balanced by the much higher rates we have to pay for transport over much shorter distances, and the general official and political apathy with which all matters connected with the prosperity of industry are treated in this country. Individually we may be a nation of shop-keepers, and fairly successful ones; but collectively the nation seems to take less interest in its trade than would be required to make a success of a shrimp barrow.

Electrical Accidents in Mines.

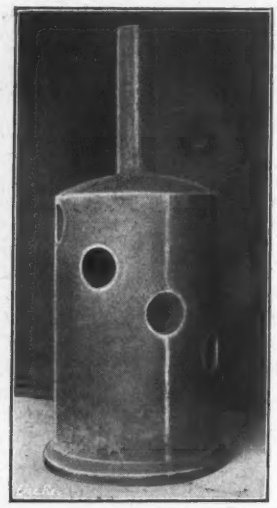
In the discussion which took place on Friday in the House on the "Coal Mines Bill," the use of electricity in the pit naturally gave the scaremongers their opportunity. Mr. W. E. Harvey said the men received with alarm the introduction of electricity into the mines. The expert opinion was that the West Stanley Pit disaster was due to electricity, and the men were looking to the Government to give them every protection in the matter.

It is when one reads such stuff as this, that one wishes every Member of the Cabinet and every Member of Parliament could be supplied with a copy of our leader of last week, and of the many previous articles on the same topic, published in our pages.

Incidentally, too, the discussion leads to the hope that some day a reformed House of Commons may contain a fair percentage of engineers, now that so much of a technical nature occupies the attention of Parliament; for when we see hon. members like Mr. Keir Hardie openly advocating a return to the naked lights of bygone days, on the ground that the use of safety lamps is only an excuse for not taking other and more efficient means to prevent explosions, we rub our eyes to be sure we are not dreaming. Mr. Keir Hardie's pleasantries in the House may add to the gaiety of nations, but not to the safety of the miner. As we write, the daily papers report another pit explosion, with fatal results, in Staffordshire—*not due*, it appears, to the introduction of electricity.

KJELLBERG ELECTRIC WELDING SYSTEM.

As mentioned briefly in a recent issue, the Kjellberg Syndicate, Ltd., has for some time been introducing the electric welding process, patented by Mr. Kjellberg into this country. The process originated in Sweden, where the parent company has been in existence for five years, and



Swedish Firebox welded throughout by the Kjellberg Process.

as in all seven companies are working the process, in various countries, it is obviously a proved one for practical purposes.

The essential feature of the Kjellberg process is the use of a metal electrode covered by a special sheath constituting a second-class conductor, which apparently acts as a guide for the molten metal passing from the rod to the weld, and at the same time enables the composition of the welding material to be suitably varied to meet the conditions of the work. Thus a weld can be obtained of any desired strength or ductility, while the great drawback of carbon welding, *i.e.*, the absorption of carbon particles in the molten metal, is entirely avoided. But the Kjellberg process has an outstanding advantage over all others, in that the welding can be done

Loco. Wheels repaired by the Kjellberg Process.

overhead equally as well as downwards, and this opens up a sphere of usefulness in boiler repair work,, as cracks or defects in the crown of a furnace can be welded *in situ* from the interior of the furnace.

Generally speaking, the process requires 120 amperes at 110 volts pressure; in practice a 200-ampere supply should be available, together with suitable resistances to reduce the pressure according to the conditions. Practically constant voltage is a necessity, but a 3 per cent. variation is allowable.

The syndicate has carried out a great variety of welding at its temporary works and in different parts of the country; we illustrate one of a number of (Swedish) vertical fire-boxes with water tubes which were welded throughout by this process, also a special piece of welding for the Swedish State Railways, over a score of driving wheels of this kind having fractured in use and been finally and successfully welded by the Kjellberg process, after gas welding had proved unavailing. In this country work has been carried out for the Coventry Ordnance Works, Messrs. Cammell Laird & Co., the Darlington Forge Co., the General Steam Navigation Co., the London Electric Supply Corporation, &c.

A valuable feature of the process is its adaptability for adding metal, thickening up corroded boiler plates *in situ*, worn journals and shafting (which can be subsequently turned up), worn rail flanges, &c.; in fact, the process seems to be well worth the attention of the tramway engineer who is still struggling with the problem of overcoming the premature wear of the rail joint as compared with the remainder of the rail. The facility with which the composition of the weld can be adjusted to requirements would appear to be specially advantageous in the above case.

Not the least interesting work carried out was the experimental welding of cast-iron and wrought-iron tips to a cast-iron propeller for the General Steam Navigation Co.; for marine work generally the process has had a wide application, many fractured stern frames of large size having been welded to the satisfaction of the marine inspection societies.

As to the cost of the process, it is many times cheaper than gas welding, and even cheaper than fire welding, while it is, of course, far more convenient and capable of turning out a clean and satisfactory job.

So far as hammer and chisel work over one of these welds could demonstrate the metallic continuity of the joint, we were, on the occasion of a visit of inspection, very favourably impressed.

The simplicity of the apparatus employed, and the apparently reliable character of the results obtained, are greatly in favour of the Kjellberg process.

IRONMONGERS AND THE SALE OF ELECTRIC LAMPS.

By H. E. GOODY.

For a long time there has been simmering in the minds of wiring contractors a sentiment of unfair treatment, on the one hand by the public, and on the other by the big wholesale firms and manufacturers.

The custom of giving the wiring work to a local contractor, and then going to the city and buying the fittings at the manufacturers' showrooms, is such a usual one as to excite no comment; and hitherto the contractor has had some little hope of profit, because he knew that he would probably be asked to supply lamps, not only at the time of installation, but also in future years for renewal purposes.

At the ruling suburban prices it is quite impossible to make a living by wiring alone, and, as I have said, the contractor has not depended on it for profit, nor has he looked to the sale of fittings for recompense. The wholesale houses have long since deprived him of that by selling direct to private customers. The supply of lamps was the rock of his financial salvation, and constituted the only department of his business which had escaped the encroachments of the wholesaler and the discount hunting of his customers.

And now the contractor is in danger of losing even this source of income. Ironmongery has enlarged its scope, and the incandescent electric lamp, the complexity and technical mystery of whose manufacturing processes should have saved it from this final disgrace, has become part of a stock-in-trade which includes putty and French nails. But it is not on a point of dignity that the case against the sale of lamps by ironmongers rests.

Supply pressures vary with the locality, so that in the case of electric lamps there are two inconstant factors—voltage and candle-power. In spite of the extended use of electricity amongst all classes of the community, there is a wonderful amount of ignorance in the matter of lamp ratings.

Nine ordinary consumers out of ten do not make any intelligible distinction between voltage and candle-power, and the question of lamp ratings is still further complicated for them by the use of transformers. Therefore it comes to this, that the average consumer, when he goes into a shop to buy an electric lamp, does not know a bit what he wants, but is compelled to leave himself entirely in the hands of the salesman, and trust to getting something that will neither glow redly like a Bastian heating element, nor give, like magnesium wire, a brilliant glare as a prelude to imminent dissolution and darkness.

To make sure that he is supplying a suitable article, it is necessary for the salesman to cross-examine his customer as to the conditions of his (the customer's) electrical supply. To ascertain the supply pressure, he will probably have to ask the customer for his address; and even then there remains the question of transformers, and to find out whether there is one installed or not the salesman may have to ask how much was paid for the last lamps purchased, and guess from that, or else give a detailed and graphic description of a transformer, so that the customer can say whether he has seen such a piece of apparatus in his house.

Of course, if a man brings his broken lamp to the shop the matter is a perfectly simple one; but that is not often done, and the task of finding out what sort of lamp is required usually devolves upon the salesman.

Thus, the chief argument against the supply of lamps by ironmongers and other electrically ignorant tradesmen is that, in the nature of things, they cannot be safely trusted to sell in any given case the right sort and size of lamp. The ironmonger sells a thousand things of common everyday use about which no inquiry of a technical nature is even remotely necessary; and it is not likely that the assistant who has just been doling out tin-tacks or dresser hooks in an entirely confident manner, free from all qualms or questionings, and who has probably never seen an electric lamp out of its wrapper, will be a trustworthy salesman of the last commodity.

The sale of electric lamps, and the giving of advice in connection therewith, are still matters of a somewhat technical nature, and they will remain so until such time as supply pressures shall be standardised, and the use of transformers rendered superfluous. When that time arrives it will not matter who sells lamps, so long as someone sells them, for all possibility of danger will have been eliminated.

Apart from the main argument as to the unfitness of ironmongers to supply lamps, there is the further question: Is it fair to the wiring contractor? Wiring contractors are a much abused class, but after all they are the class chiefly to be looked to for the popularisation of electricity, and if their business is going to be made quite unprofitable by wholesale methods and public indifference, they may revolt in a body and devote themselves to gas-fitting. I say this in all seriousness. It is difficult to exaggerate the influence of the wiring contractor, and unless it is made worth his while to stick to his trade, he may use his influence in recommending some other illuminant which it pays him better to install.

The lamp manufacturers are to blame. Several firms which recently embarked on immense advertising schemes, have made a point of getting ironmongers and house decorators to take up the sale of their lamps. They give them the same trade discount as they give the wiring contractor, and in their lamp lists and pamphlets they use the horrible phrase "to be obtained of all ironmongers." The fact of the matter is these firms have treated the wiring contractors very badly from the beginning. One firm at least will supply anyone who cares to journey to them with lamps at trade discount; and as if this were not sufficient, they have lowered the discount to such a point that, what with the inevitable breakages, it hardly pays the contractor to stock these lamps. As a consequence, contractors, whenever possible, supply lamps of a less well-known make on which they can make a larger profit.

The delinquent manufacturers are now attempting to force the hands of the contractors. They say "we will make the name of our lamp a household word by means of extensive advertising, so that continual inquiries therefor will compel you to stock it whether you like our terms or not; and furthermore, in case you think we are dependent on you for the distribution of our products, we will supply the public through the media of ironmongers, oil and colour shops, and house decorators."

I am no prophet, and for me the final issue of these belligerent preparations is wrapped in obscurity; but it does not seem likely that even the biggest lamp manufacturer will be able to ride roughshod over all the electrical trade interests (excluding, of course, his own).

I would not for a moment abuse or discourage any business method which tended to the popularisation of electricity; but the particular method criticised in the preceding paragraphs is certainly not calculated to do anything of the sort. It simply means taking the supply of a certain commodity from the hands of a class of men who are competent to surround it with intelligent safeguards, and putting it in the hands of men who, however well-meaning, have not the necessary knowledge or ability.

Lamp manufacturers would, I think, be well advised to refuse to supply any trader with lamps at trade discount, unless the said trader is himself, or has in his employ, a person of electrical training and experience.

A NOVEL COUNTRY HOUSE INSTALLATION

By FRANCIS H. DAVIES, A.M.I.E.E.

In the ordinary course, one country-house installation is very like another, and whatever form of motive power be employed, there is generally little of a distinctive nature about the generating machinery or any part of the plant. There are, however, exceptions, and the subject of this article may be deemed a noteworthy one, since power for lighting, heating and cooking is derived from a motor-car engine without in any way interfering with the regular use of the car.

The installation, which is situated some few miles out of London, has now run successfully for close on two years, and having thus passed the experimental stage, some details of the equipment may be of value.

Fig. 1 shows the arrangement of the generating plant, which consists of a 5½-KW. British Westinghouse dynamo driven by the car engine at 1,650 R.P.M. The car itself is a 20—28-H.P. four-cylinder Darracq, the engine of which

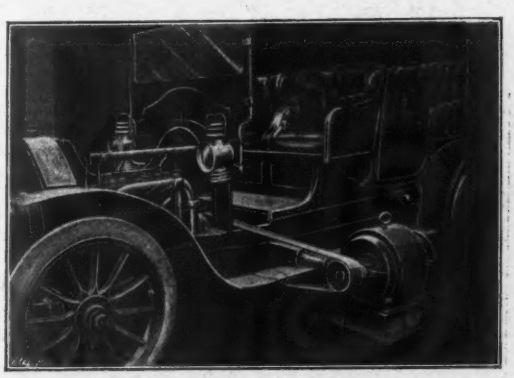


Fig. 1—Car-Engine Driving Dynamo.

runs at 750 R.P.M., and drives the dynamo by means of a 13-in. special split pulley fixed to the shaft on the engine side of the clutch. The length of the drive is 6 ft., and a 3-in. Gandy belt, fitted with Jackson fasteners, is used.

It will be seen that the dynamo is mounted on wooden blocks, the whole being held together by two straps and four bolts. The belt is kept tight and the length of the drive fixed by means of a screw jack bearing on a block of wood placed against the car frame, as shown. There is just sufficient clearance on both sides for the belt, which runs without any trouble. It will be obvious that the ca

cannot be placed in exactly the same position every time it is required to use the dynamo, and hence the latter is not fixed to the ground in any way, but depends for stability entirely upon its own weight and the jack. The success of the arrangement is probably due to its simplicity, which, however, is the result of a considerable number of experiments with other drives. It could no doubt be applied to numerous classes of cars, but it is unlikely that every make and size would afford the necessary clearance for the belt and special pulley, and those two points will usually be found to constitute the chief difficulty. To keep the engine as cool as possible it is run with the bonnet off, and the tires are pumped hard in order to give rigidity. Paraffin at 4½d. a gallon is used in the engine without any alterations to the carburetter, it being found necessary only to heat the induction pipe by a blow lamp at the commencement of the run. At the normal load of 4 KW. the engine consumes 1 gallon of oil in 1½ hours, and the fuel cost thus works out at the low figure of ·75d. per unit.

As a considerable amount of energy is used for cooking, &c., a comparatively large battery of 200 ampere-hours' capacity has been installed. It is of the Tudor type, and part is housed, as shown in fig. 2, in a simple wooden erection, which readily takes to pieces in order to give free access to the cells. The remaining part of the battery is in an adjacent shed, which contains among other tools a lathe driven by a ½-H.P. motor. As there is ample margin in the generating and battery plant, it is proposed to extend the use of power to water pumping and lawn mowing, thus enhancing the usefulness of the car and its engine to an extent undreamed of by the average motorist.

An interesting point about the installation, which is the outcome of increased use of the cooking apparatus, is the provision of a two-voltage supply. The orignal installation was run at 50 volts, but this is now only employed for lighting, and the cooking apparatus is operated at 70 volts off the whole battery. Three bare overhead wires, some 35 ft. long, transmit current to the house, where the supply is tapped off at 50 volts or 70 volts, as may be required.

The cooking installation, by reason of its completeness and the fact that practically all culinary operations are performed with it, is of particular interest. Further, very careful records have been kept, and it is hence possible to give authoritative data of consumption, &c., in everyday practical use. The whole of the apparatus is of the Economic type of Messrs. F. A. Wilkinson & Partners, Ltd., Harpenden, and the range and oven is illustrated in fig. 3. In addition, there is installed one 700-watt toaster, one 600-watt rapid heater, one 1,000-watt combined stove and radiator, one 1,000-watt lamp substitute radiator, and one

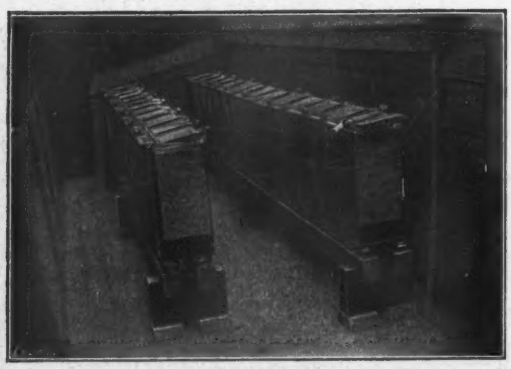


FIG. 2.—BATTERY INSTALLATION.

700-watt heater on the Tubead system. The oven has four heats, and is equipped on the top with grilling and boiling attachments, each of which has two heats. There is also the usual lamp indicator board, on which are placed the switches, as it has been found by experience that this is the only satisfactory course. Ordinary household utensils are employed, the construction and design of the apparatus rendering flat-bottomed or special utensils unnecessary. The range on the top of the oven is so designed that boiling operations can be carried out simultaneously with grilling and toasting beneath, and a metal slide is provided to deflect the heat when one operation only is carried on at a time.

A great deal of data as to cost, &c., are available, but the following have been selected as typical of the results ordinarily attained :—

7½ lb. of beef, potatoes, cauliflower, rice, rice pudding. Consumption 3·9 units.

1½ lb. of lamb, 2 lb. fish, potatoes, asparagus, custard pudding, fish sauce. Consumption 3·8 units.

Four chops grilled simultaneously with the boiling of a cabbage and potatoes. Consumption 1·9 units.

Large slices of toast are made at the rate of one slice in two minutes with a consumption of 600 watts per hour.

FIG. 3.—ELECTRICAL COOKING RANGE.

Three pints of cold water are boiled on the rapid heater in an ordinary tin kettle in 23 minutes with a consumption o 600 watts per hour.

As the cooking circuit is metered, the above figures are accurate. For this purpose a Siemens watt-hour meter is installed, and the lighting circuit is provided with an ampere-hour meter.

The total cost of the installation, excluding the car but including wiring for some 25 lighting points, amounted to £98, a very moderate figure, largely contributed to by a simple system of surface wiring. Armoured flexible has been used throughout, and installed in such a manner that in the event of a change of residence it could be taken out and used over again with a minimum of expense. This consideration had, indeed, an important bearing upon the whole design of the installation, which, in fact, might be moved with facility in a few journeys of the car, and with a minimum of cost in making good.

Tripoli.—Just before the war broke out the municipal authorities were in correspondence with the Minister of Public Works in Constantinople for permission to invite public tenders for the construction of such necessary utilities as water supply and sewerage schemes, electric lighting, and tramway plants and a public telephone service. After the war is over——

Syria.—An American Consul reports that the Municipal Government of Aleppo has had plans and specifications prepared for the construction and operation of an electric tramway for this city, covering all of the main thoroughfares; also for an electric lighting system to take the place of the present antiquated petroleum lamps. "It is desired to grant the concession for the two projects to the same concern, and at the same time in order to ensure better success and more economical service. It appears probable that the power may be conducted by cable from the Daphna Falls, or from the Orontes River, both near the city of Antioch, a distance of some 60 miles from Aleppo. Inasmuch as there are no means of locomotion in Aleppo, estimated to have a population of 200,000 to 250,000, except by carriage, which must be driven over exceedingly rough stone streets, and as there are no lighting systems such as electricity or gas, there is little doubt that the two propositions, taken jointly, would provide a lucrative profit to the concessionaires."

TWO-WATTMETER METHOD OF MEASURING POWER IN THREE-PHASE CIRCUITS.

BY D. H. OGLEY, B.Eng., Royal Technical Institute, Salford.

THIS method of power measurement is apt to confuse many, for whereas the two meters are connected in a precisely similar manner, their readings in general vary. A little consideration will, however, make the reason for this clear.

Suppose that it is required to measure the power supplied to a three-phase induction motor, the stator of which is star connected.

The thick, or current, coil of each wattmeter is connected in series with one of the supply mains and one of the terminals of the machine, while their volt coils are connected between the same mains and the third line, as shown.

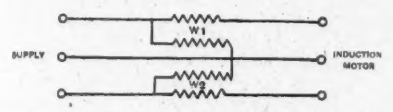


FIG. 1.

In this case of a three-phase star-connected circuit, the E.M.F.'s acting differ in phase by 120°. Let O M, O N, O P (fig. 2) represent the maximum values of the P.D.'s between the ends of the stator circuit and the neutral point.

Then M N will represent, in relative phase and magnitude, the P.D. between the points M and N or between two stator terminals. Similarly M P and N P will represent the P.D.'s between the points M and P, and N and P, or between the other terminals.

M N, M P, N P, thus represent in relative phase and magnitude the line voltages.

Let V represent the maximum value of the P.D. between any line and the neutral point. Thus V is represented by O M, O N or O P.

Then M N, M P or N P $= V\sqrt{3}$.

Since the motor circuit is an inductive one, the current lags behind the E.M.F.

Let $o\,m$, $o\,n$, $o\,p$ represent the current lagging by an angle θ.

Now from fig. 1 the current through the main coil of wattmeter W_1 is represented by $o\,m$, while the P.D. across the terminals of the pressure coil is represented by M N.

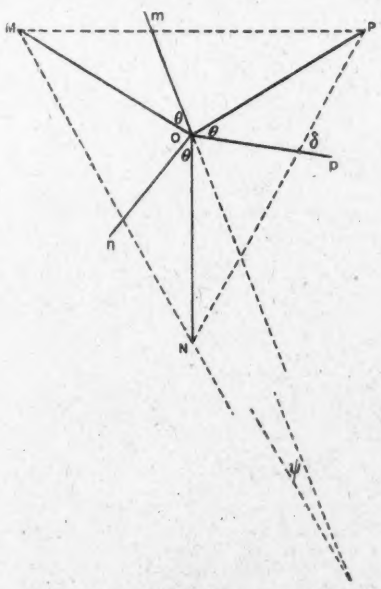


FIG. 2.

The angle ψ of phase difference is obviously $\theta - 30$.

The angle δ—the angle of phase difference between $o\,p$ and N P—representing current and pressure values for W_2, is $\theta + 30$.

Let W_1 be the reading of the first wattmeter,
" W_2 " " " second wattmeter,
" I represent the maximum value of the current.

Then $W_1 = \frac{\sqrt{3}}{2} V I \cos(\theta - 30)$,

$W_2 = \frac{\sqrt{3}}{2} V I \cos(\theta + 30)$.

These values will vary, of course, with the value of θ.

Thus for $\theta = 30$,

$W_1 = \frac{\sqrt{3}}{2} V I$,

$W_2 = \frac{\sqrt{3}}{2} V I \cos 60 = \frac{\sqrt{3}}{2} V I \frac{1}{2} = \frac{\sqrt{3}}{4} V I$.

It is thus clearly indicated that the readings on the two wattmeters will vary, until as θ gradually increases and at length becomes equal to 60°, W_2 reads zero. If θ becomes greater than 60°, as it probably will do if the motor is running light, then W_2 reads in the reverse direction. This may necessitate the reversal of the shunt-coil in the case of some wattmeters, and the two readings will have to be subtracted to give the total power.

For any case :—

$$W_1 + W_2 = \frac{\sqrt{3}}{2} V I \{\cos(\theta - 30) + \cos(\theta + 30)\},$$

$$= \frac{\sqrt{3}}{2} V I \sqrt{3} \cos\theta,$$

$$= \frac{3}{2} V I \cos\theta,$$

which is clearly the total power in the circuit.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

A Reliable Rectifier Wanted.

Your correspondent "J. R." seems inclined to invert the natural order of things, which conserves the type but is prodigal of the individual, for he appears to be willing to reprobate the species without having had experience with the unit.

Being interested in the "Batten" rectifier, I, upon reading his letter, at once offered my services with the view of getting him out of his difficulty with his instrument, only to find that he had not one. Considered in this light, his mention of the name of "Batten" was not cricket.

In the event of my experience in the matter of rectifiers being considered at all interesting, I should like to be permitted to give a little history of the invention. In 1900, a medical friend had the alternating current led into his house, and as he had already made use of the suave assistance of Demoiselle Elektra in his practice, he hailed the advent of an unlimited supply with delight, which rapidly ebbed as limitations of its usefulness from a chemical and electrotherapeutical point of view unfolded themselves. My assistance was invoked, and we set to work together to straighten out some of the kinks. Small synchronous motor commutators, in air, in spirit, and in paraffin were tried, worked and abandoned. Electrolytic rectifiers were found to need enormous mass and superficial area of plates or liquid, and even then only worked passably well when the cells were water-jacketed to keep the temperature somewhere near normal. Then electrolysis at joints gave us trouble. A limited experience with vacuum rectifiers promised little and performed less. Being a telegraph man, I knew very well that a speed of vibration of 100 per second offered no difficulties to a small properly pivoted polarised armature moving between two rigid stops, and upon these lines a new form of relay was designed and formed the basis of the "Batten" rectifier. This I have found little difficulty in adapting to any normal requirements, but for reasons best

known to themselves, the supply companies are generally most unreliable in their statements with regard to frequency, and this is a vital point, not on account of the vibrating armature, but the efficiency of the transformer, which forms an essential part of the apparatus. A modification of the instrument, breaking the circuit in mercury at a point in the phase when the voltage was highest, enabled us to work an X-ray tube spark coil direct off the secondary of the transformer. As far as I know, the few rectifiers of this type that have been constructed upon the original lines have given every satisfaction when intelligently used, and in more than one case of motor engineers they have done good work in charging spark coil accumulators on business lines, and have paid for their small first cost many times over. Our troubles have been commercial rather than technical or experimental, the apparatus having proved itself thoroughly reliable if given a chance to prove its merit.

Geo. Sutton.

Dulwich, *November 23rd*, 1911.

Operators in Electric Theatres.

I have read with interest the article on electric theatres in your issue of November 17th. I have come in contact with several operators and know that they experience considerable difficulty in obtaining efficient theoretical tuition in their particular branch of the profession. Their salary debars them from participating in private coaching, while the technical classes are of no use to them, because their presence is required every evening at the theatre. Perhaps special day technical classes at the various large centres would overcome the difficulty.

Bearing out your correspondent's remarks, at a local theatre, at which we were informed the arc was hissing and flickering badly, a visit revealed the fact that the pressure (D.C.) across the arc was 90 volts, the current at the same time being over 90 amperes. The arc and carbons seemed to consist of a single ball of fire, the whole of the carbons running red hot. The temperature inside the operating box was unbearable to an outsider, yet the operator seemed proud of the fact that he could produce such an effect.

The condenser requires replacing about every month, the forces set up due to the violent expansion and contraction of the metal case eventually fracturing it; while, at the same time, a special shutter has to be provided to shield the film when stationary, otherwise it inevitably catches fire.

Daniel H. Ogley,

Royal Technical Institute, Salford.

November 22nd, 1911.

Electricity in Mines.

You are rather hard upon the colliery electrician. There are probably good men who, through no fault of their own, cannot keep the electrical appliances below ground in good order. Take a main road underground, with power cables, lighting cables and signal cables running along it. This is a very bad road, the road constantly lifting, the bars breaking, and falls of roof very often taking place. Datallers are working at it every night, timbering and removing the dirt. The cables are dropped on the floor and covered with wood while this work is going on (at least they are supposed to be, but very often they are left uncovered, and it is not a difficult matter to tell the treatment they have had). When they have finished they will tie all the cables together, and sling them on to a piece of iron or a nail; in fact, they think that they will do anyway; "it's only a cable" being an expression that is often made use of.

This work is going on night after night, week after week. How can anyone keep cables in good order that are being knocked about like this? The electrician knows how bad the cables are; he reports to the management that the road is not fit for cables. He is told that there is no other way, and they are bound to have the current on, and he must keep them in as good a condition as possible. Consequently, they are being worked in an unfit condition. This is one of many cases where the electrician is not to blame.

You also mention the responsibility of the colliery manager being shared with a certificated engineer. The President of the Association of Mining Electrical Engineers stated in his Presidential address that the electrician must always be subject to the engineer. I do not know who he means by that. If the colliery manager is meant, it is all we can expect at present; but if enginewright is meant, it can hardly be expected to raise the status of an electrician when he has to be subject to a carpenter or a blacksmith, as these are very often the men who are appointed to the post of enginewright. I want more responsibility to be attached to the electrician; he would then have a say as to his apparatus and his men. It would be bound to improve the use of electricity in mines.

Interested.

The Cash Value of Electrical Knowledge.

The following is an advertisement from yesterday's *Manchester Guardian*:—

> Wanted, in Mains Department of Electricity Supply Station, near Manchester, Man to install, maintain and repair motors, and make himself generally useful in the department; one able to fix and read meters; wage to commence, £1 per week of 50 hours, with prospect of increase for satisfactory man. Address, &c.

There is not much to say about this—it speaks for itself—except to express the pious hope that the "prospect" will not be too dazzling for the satisfactory prospector's eyesight. If this advertisement emanates from a public body, it is a public disgrace; if from a private company, the latter deserves the disaster it is courting in employing skilled labour at this figure.

John S. Leese.

Manchester, *November 22nd*, 1911.

P.S.—The Institution of Electrical Engineers would, I suggest, be more profitably employed in the investigation of such cases as the above than in chopping and changing its internal rules and regulations, with which pastime it appears to be exclusively engaged at the present time.—J. S. L.

THE SUBTRACTIVE PRODUCTION OF ARTIFICIAL DAYLIGHT.

Messrs. Ives and Luckiesh have recently described a series of experiments on the subtractive production of artificial daylight, the results of which are of the greatest importance in cases where true colour values must be realised, even at the cost of extravagant production.

Gas flames and electric glow lamps have a deficiency of blue and an excess of red rays as compared with daylight, and in fig. 1 (curve T) are shown the relative intensities of various colours in average daylight and in the light from a tungsten lamp when giving approximately the same illumination. To correct the colour of the tungsten light, the redundant rays may be absorbed by a colour screen, the transmission of which should be the reciprocal of the relative brightness of the illuminant and daylight at every point of the spectrum.

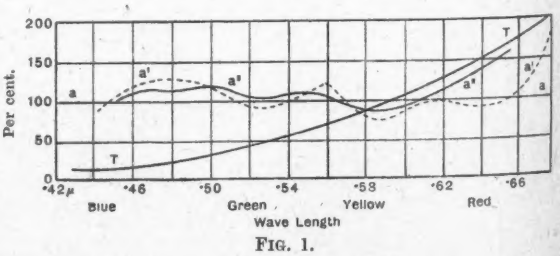


Fig. 1.

The transmission curve of such an ideal medium is as shown at *a*, fig. 2; curve *b* shows the actual brightness of tungsten lamp radiations, and *c* shows the same after absorption by the screen *a*. The candle-power of the filtered light is about 15 per cent. that of the original light, *i.e.*, the "daylight" efficiency of tungsten lamps is about 10 watts per m. spher. c.p.

It is, of course, impossible to obtain an absorbing medium exactly conforming to the ideal curve *a*, fig. 2, particularly in view of the variable nature of daylight itself. So long, however, as the artificial daylight merely differs from *a*, fig. 1, by a reasonable

amount progressing smoothly towards the red or blue end of the spectrum, we are merely matching a different quality of daylight.

The human eye can adapt its colour scale to suit any reasonable approximation to daylight, and a light having a "humpy" spectrum can yield quite a good impression of daylight, but, some colours being partially or wholly absent, will not give true colour matching of monochromatic colours. Actually, however, most colours dealt with in everyday work are very complex mixtures, so that it has been found quite possible to get satisfactory results from a screen yielding a more or less "humpy" spectrum on the emergent side.

Coloured glass is preferable to dyed films or liquid filters as a colour screen material, owing to its greater permanence, more practical nature and distributed absorption characteristic (dyes have a sharp, local absorption).

Cobalt-blue glass transmits blue rays, an isolated yellow-green band and deep red; placed over a tungsten lamp, it yields a purple light. Signal-green glass reduces the red rays transmitted by cobalt-blue, but, used alone, yields too green a light. A good combination of the two may be found by trial with a pair of carefully ground wedges, the outstanding yellow-green transmitted by the combination being absorbed by a screen of gelatine

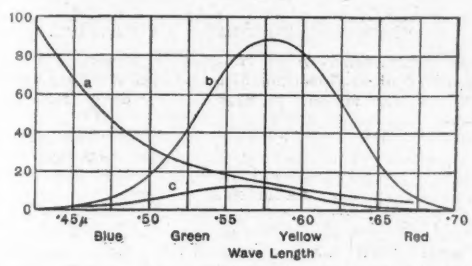


Fig. 2.

dyed with rozazeine. The spectrum of the light transmitted by this combination shows "humps" in the red, green, and blue (see also fig. 1 in which a' refers to the first screen derived by careful trial and error, and a^* refers to a screen built up from ordinary market grades of glass).

For testing purposes, a box containing frosted-tip tungsten lamps was fitted with a double bottom—one of a colour screen built as above, and the other of frosted glass for diffusing purposes. On the testing surface below the box, the illumination obtained was 30 ft.-candles; testing the window illumination by a colorimeter shows:—Red, 100; green, 85·4; blue, 75·8. (Daylight 100; 100; 100.)

It is fortunate that two standard market glasses form such an excellent combination, giving quite good enough results for most practical purposes. A skilled glass worker could doubtless find a better pair of glasses or even a single tint answering the desired purpose, and it is especially desirable that the dyed screen be replaced by a more permanent material.

On a colour sensation basis, the artificial daylight obtained by the above means is a closer approximation to average daylight than any other known artificial illumination. True, its efficiency of production is only 1/10 to 1/12 c.p. per watt, but the first cost of the apparatus required is very low, and the component parts are very easily and cheaply renewable, while the high energy cost is fully justified in most cases where the special light is really desirable.—*Electrical World*

LEGAL.

Electricity Supply Inspection at St. Pancras.

At the Clerkenwell Police Court on November 22nd, before Mr. Bros, the hearing was resumed (adjourned from November 2nd) of an application by Mr. Stanley Syer (of Macdonald, Syer & Co., Ltd., electrical engineers, of Gray's Inn Road), as a consumer of electricity supplied by the St. Pancras Borough Council, for the appointment of an inspector under the local Electric Lighting Act.

At the previous hearing, Mr. R. Tweedy Smith, solicitor, appeared for the applicant, and Mr. Barrington Ward as counsel for the Borough Council, appeared to resist the application. Applicant disapproved of the type of fuse insisted on by the Council, but found that he could appeal to no one to decide the question, as the Borough Council electricity undertaking was not under the inspection, for this purpose, of the London County Council. The local Act provided than an aggrieved consumer must ask the Stipendiary of the district to appoint an inspector. It was then stated that the Council had, in the interim, received a letter withdrawing the appointment, and stating that it was proposed to proceed "in another way." Mr. Smith said that a test case was proceeding in the High Court. A second application was also made at the same time by Edward Evans, of Fitzroy Square, on public grounds, of possible danger to users.

At the resumed hearing, Mr. Ward said that he would not resist the appointment of an inspector to deal with the two cases in question, but was of opinion that it would be inadvisable to appoint an inspector generally to deal with all cases that might arise on the question of expense. He suggested the appointment of Mr. C. A. Baker, M.I.E.E., principal assistant in the electrical department of the London County Council, as a suitable person.

Mr. Smith, however, for the applicants, pressed for an inspector authorised to deal with all complaints received, and not only the two in question. The Electrical Contractors' Association had already, he understood, a number of cases of complaints, and he asked for the appointment of a permanent inspector. St. Pancras, and also Chelsea Borough Councils, he said, had slightly different powers in dealing with electricity supply from other London Borough Councils, having been the first two Councils to take up the matter. Unless a permanent inspector were appointed every dissatisfied consumer would have to make a separate application to his Worship in each case. As to the question of costs, there had been no difficulties arise in other London areas, as the Act provided that the fees should be paid in advance, and the undertakers (in this case the Borough Council) were only responsible in the case of their work being proved faulty.

Mr. Harding, who appeared for the L.C.C., said that if his Worship decided to appoint anyone in the present service of the L.C.C. as inspector, he would ask him to say that the inspectorship would cease if the person specified at any time left the service of the L.C.C.

After some further argument on the interpretation of the Act, the magistrate said that he was willing to appoint Mr. Baker as an inspector to deal with complaints generally. This appointment would date from January 1st, 1912, and would be for 12 months. The question of remuneration was left over for the time.

Both parties agreeing to this, the appointment was accordingly made.

A Dumbarton Tramway Case.

Owing to the rowdy conduct of some boys on the top of a heavily laden workmen's car one morning recently, the tramway officials ran the car off the direct route in the direction of the depôt, with the object of bringing the car to the nearest point to the police office.

Great inconvenience was caused to the workmen as they were forced to walk about half a mile on foot, and as they were refused the return of their fares, a test case was brought before Sheriff Blair, at the Dumbarton Small Debt Court.

The Sheriff refused to decide the question of breach of contract, and considered that the company were quite entitled to run the car either to the depôt or anywhere else if destruction of their property was threatened.

He thought, however, that peaceful passengers should have had their fares returned, and accordingly granted decree for ½d., with 7s. 1d. expenses.

Crompton & Co., Ltd., *v.* W. B. Haigh & Co., Ltd.

In the Lord Mayor's Court, on Friday, before Assistant Judge Jackson and a jury, a claim was made by plaintiffs, of Chelmsford, against defendants, who are manufacturers of wood-working machinery, of Oldham, to recover the price of an electric motor supplied. The plaintiffs' claim was admitted, subject to a counterclaim by defendants for damages.

Mr. Gwyer, for the plaintiffs, said that the question the jury had to consider was whether the defendants were entitled to their cross claim against the plaintiffs, they having admitted the plaintiffs' claim. In September, 1910, the defendants, who did a large business in supplying the Government home departments and also foreign Governments with wood-working machinery, had an inquiry from the Government of Italy with reference to a circular saw mill, which they required to be erected at their works at Florence. An electric motor was required to drive the saw, and the defendants, who did not manufacture electric motors, asked the plaintiffs for an estimate for the supply and erection of a number of different varieties of electric motors. This was with a view to enabling the defendants to see what sort of motor they could get, and the time for delivery, because they contemplated tendering to the Italian Government. Fortunately, the whole of the transactions that passed between the plaintiffs and defendants were in writing. The defendants had in the course of the correspondence informed the plaintiffs that the electric motor required was for the purpose of being supplied to a foreign Government. A quotation was received from the plaintiffs. The defendants, in consequence of the information received as to the delivery and price of the electric motor, sent a tender to the Italian Government. The defendants' tender was accepted, and the plaintiffs were given instructions to proceed with the work of delivering a certain electric motor to be supplied by February 20th, but the motor was delivered on April 6th. In consequence of the delay on the plaintiffs' part, the defendants, it was contended, were liable, or would become liable under a penalty clause in their contract with the Italian Government, for 1 per cent. of the amount of the contract of £121, for every 15 days' delay. There was a delay of 37 days, and the defendants claimed £3 under this head. They also claimed £13 10s. for expenses and labour incurred in having to pull down and re-erect the saw bench, owing to the plaintiffs' delay.

It was contended by Mr. Morle, who appeared for the defendants, that the plaintiffs knew, or ought to have known, from the letters passing between the parties, before the order was given, that it was in connection with machinery to be supplied under a Government contract, and that the delay would incur a penalty. Evidence was given in support of the defendants' counterclaim.

For the plaintiffs, it was submitted there was no case for them to answer. The plaintiffs had no knowledge of the contract which the defendants had with the Italian Government, and even assuming there was a breach by the plaintiffs, then the damages, as had been proved, were hopelessly remote and could not be recovered by the defendants.

The Assistant Judge said he would not take the case from the jury.

Counsel for the plaintiffs said he could not usefully call evidence, because the facts were admitted.

Evidence, however, was given by Mr. Sidney Robert Smith, assistant secretary of the plaintiffs' company at Chelmsford, who said the plaintiffs had no knowledge of the defendants' contract apart from the letters which had passed.

For the plaintiffs, it was contended that they had not broken the contract. They were late in delivery, but this was occasioned, as they were informed, by an unfortunate series of accidents to one of the end covers of the electric motor. If there was a technical breach the defendants had proved no damage.

The jury found a verdict for the plaintiffs on the claim and counterclaim, and judgment was entered accordingly.

Fyfe, Wilson & Co. *v.* Wakelin Bros., Ltd.

Before Mr. Justice Coleridge in the King's Bench Division, on November 22nd, plaintiffs of Glasgow, sued defendants of London, for the balance of an account for Kelvin petrol-electric generating sets. The defendants alleged that the machines would not do the work for which they were sold, and that by reason of defects they frequently broke down. They counterclaimed £220 for loss of profit and expenses. The plaintiffs denied the allegations in the counterclaim.

According to the report of the case in the *Glasgow Herald*, Mr. Willis, for the plaintiffs, said the only contest in the case would be on the counterclaim, as the plaintiffs had already recovered the price of two of the machines supplied. The defendants, who were the plaintiffs' selling agents in London, alleged that the machines were not in accordance with the contract, but he would call a large body of expert evidence to show that they were. The first item of the plaintiffs' claim was in respect of a demonstration set supplied to the defendants, which was to remain the property of the plaintiffs unless defendants purchased it. When Mr. Fyfe in February of this year called at defendants' place to see it, however, he was told he could not do so, and that it was the property of the defendants, although they had not paid for it.

A large number of expert witnesses gave evidence as to the effectiveness of the dynamo and engine supplied by the plaintiffs.

At the close of the evidence for plaintiffs, his Lordship intimated that he was against the defendants on the counterclaim in respect of loss of profits on the sale of six sets of machines.

In opening the defendants' case, Mr. Lynch admitted that his clients sold the demonstration set supplied by the plaintiffs in July last, and had not paid for it, but he claimed that as the machine was sold in place of one which had been found to be defective, the plaintiffs had no right to sue for the purchase price. The machine was guaranteed to give 75 amperes, but it would only produce 60 amperes.

The hearing was adjourned.

Anglo-American Telegraph Co., Ltd.

On Tuesday, November 28th, in the Chancery Division, Mr. Justice Joyce gave his sanction to the extension of the objects contained in the memorandum of association of the Anglo-American Telegraph Co., Ltd., so as to include the sale of the undertaking of the company. The petition was unopposed.

Mr. Younger, K.C., said when the matter was before the Court on a former occasion, his Lordship was not satisfied that the Court had power to sanction such an arrangement. He (counsel) now produced a decision of Mr. Justice Parker, which was supported by other decisions showing that the Court had power.

In this case the transaction his Lordship was asked to authorise, was of a very far-reaching nature, and the matter arose in this way. The Anglo-American Telegraph Co., Ltd., whose petition was before the Court, was incorporated in 1866, and acted as the pioneer of cable business in the Atlantic. At first it was in absolute command of the field, but shortly afterwards very active competition was commenced. Between that time and 1882 it was found necessary to enter into certain pooling agreements between the companies, and in 1882 an arrangement was entered into between the Direct Co., the Anglo-American Co., the French Co., which had a special cable between France and America, and the company which afterwards became the Western Union. A pool was thus constituted in all the cable business of America and Canada upon terms. In the ordinary course of events this arrangement would come to an end in the year 1920. The Western Union possessed the land-line in America, which was necessary in order to enable the messages to be conveniently transmitted. In 1911 the Western Union came to the conclusion that the working of the cable business should all be in one control, and with this object in view they approached the other companies mentioned. These negotiations were proceeding when the Western Union were advised that under the Sherman Anti-Trust Law they exposed themselves to a prosecution, because they were parties to a trust. On February 10th, 1911, the Western Union gave notice to terminate their connection with the other companies under the pooling agreement of 1882, on the ground that they were no longer bound by that agreement under American law. The Anglo-American Co. took the best advice available in America and in England, and they were advised that the view taken by the Western Union was the correct view. They then had to consider what was the next best arrangement to be made. The Direct Co., who were also parties to the pooling agreement, took the same view, and on August 7th, 1911, two agreements were entered into—one between the Western Union and the Anglo-American Co. and the other between the Western Union and the Direct Co. These agreements were to last for 99 years, and the shareholders were to receive £262,500 a year, which would provide a very substantial dividend, exceeding what they had been receiving in the past years. To carry out this agreement between the Anglo-American Co. and the Western Union it was essential that the objects of the memorandum should be extended. The petition did not ask for the Court's approval of the terms of the agreement, but asked his Lordship to say that the company had power to enter into such an agreement. The necessary resolutions had been unanimously passed by all classes of shareholders, and there were no creditors concerned. Everybody interested in this matter had been overwhelmed with responsibility, and the present scheme was the best in the interests of all parties.

His Lordship made the order asked for in the petition.

Meyer *v.* Sachsenwerk Licht, &c., Co.

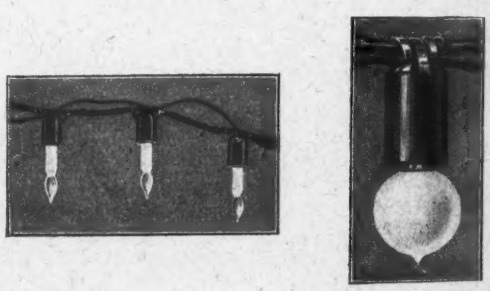
A common jury, sitting with Mr. Justice Lawrence in the King's Bench Division on November 27th, awarded £47 damages to the plaintiff in this action in respect of a claim for wrongful dismissal.

The plaintiff, Mr. Ernest Meyer, was employed from 1902 to 1907 by the Electric Motor-Dynamo Co., whose operations consisted mainly of supplying electric motors to factories and workshops, his remuneration being in the form of a weekly salary and commission. According to the terms of the agreement, the service was terminable on three months' notice terminating at the date of the year upon which the appointment was made. In 1907 the business was taken over by the defendant company, a German company, whose business in this country was carried on by agents at Finsbury Street, E.C., and the plaintiff's services were transferred to them. In 1910 he received notice of the intention of the agents to put an end to his agreement, but before the term expired he was dismissed in consequence, according to counsel for the defence, of his having extended a week's leave of absence in Germany, to 16 days, and his neglect to obey the lawful orders of his employers. An effort had been made, said plaintiff's counsel, to prevent the action being brought in England, but the matter had gone before a judge in chambers, who had decided against the defendants. The evidence as to the cause of the dismissal was of a conflicting character, but in the result the jury found for the plaintiff, giving him £47 in lieu of salary, but refusing to allow a claim for commission which might possibly have been earned during the period.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Christmas Decorations.

The Electrical and Engineering Supplies Co., Ltd., of 36 and 37, Upper Thames Street, London, E.C., have just issued a pamphlet regarding their decorative electrical outfits, particularly suitable for Christmas trees and shop-window displays. The



Figs. 1 & 2.—Decorative Lamps.

accompanying figures show suspended lamp and candle lamp sections. All live parts are totally enclosed, and for ordinary window dressing or in the foliage of Christmas trees the devices should be used with excellent effect and safety. Copies of the price list will be sent on application.

New Abbey Flame Lamp.

We are now able to give some further particulars of the new single-enclosed flame arc lamp recently brought out by the Abbey Electric Co., of 17, Victoria Street, London, S.W., and exhibited by them at the recent Electrical Exhibition at Olympia for the first time.

The alternating lamp burns for 50 hours on one pair of carbons, and the cost of carbon consumption has been reduced to the extremely low figure of ·06d. per hour, or about 15 hours for 1d.

The lamp has one pair of carbons arranged vertically, and is fitted with a special device for cooling the gases given off, thus

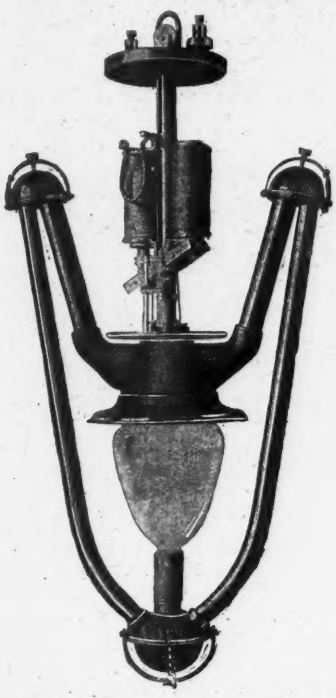


Fig. 3.—Mechanism of the Abbey Flame Lamp.

always keeping the globe clean from deposit below the arc. The method of cleaning and trimming the lamp is very simple, the tubes, which can be seen in the accompanying illustration, having three openings, two at the top and one at the bottom of the lamp, so as to allow of a small brush being passed through, to take away all the deposit which has collected there. The dome or cap for fastening up the aperture at the ends of the tube is kept

Fig. 4.—The Abbey Flame Lamp.

in place by a small thumb-screw and bow-shaped spring, the dome itself being permanently attached to the latter by a short flexible chain.

The globe is removed for trimming by simply pressing down the short brass tube, shown in the illustration, connecting the bottom of the globe with the tubes. This short brass tube has a spiral phosphor-bronze spring inside which keeps the globe in position and allows at the same time for the expansion of the glass when heated. The carbons are, of course, inserted in the same way as in an ordinary enclosed lamp, the mechanism consisting simply of the usual shunt and series differential solenoid control with clutch feed.

The carbons used are short, and of a very substantial type, there being enough of the top carbon left after a run of 50 hours to make two trims for the bottom; thus every particle of carbon is used up, except that held in the bottom carbon-holder, which is about ¾ in. long. The whole of the lamp, tubes and framework and all the castings are made of either brass or copper, and are entirely insulated from both terminals.

The light given by these lamps is of a whitish yellow, though a pure white carbon is supplied for special cases, which has a very good efficiency for use with any sort of colour work. The maximum candle-power is given at an angle of from 10 to 15° below the horizontal, resulting in an even distribution of light over a large area.

The arc voltage is from 40 to 45 volts, and the current from 8 to 10 amperes according to requirements, thus giving a lamp which takes only from 350 to 450 watts.

These lamps will burn on alternating current either in single-parallel on 50 volts, or two in series on 100 volts, four in series on 200 volts; in the latter case, a very neat substitutional resistance and automatic cut-out is fitted inside the lamp case. The object of the makers in bringing out this lamp has been to give the burning hours of a magazine, with a simple mechanism, at a low initial cost, together with a very low price for maintenance.

Drawn-Wire Mazda Lamps.

The accompanying illustration shows a device employed for testing the strength of Mazda drawn-wire tungsten lamps at the Electrical Testing Laboratories, New York. The arm upon which the lamp is mounted is brought to a constant position by each revolution of a small cam, and is allowed to drop freely upon a spiral cam, with which the drop can be varied from 0·01 in. to 4 in., with a constant increment of 0·01 in. per revolution. The fall at

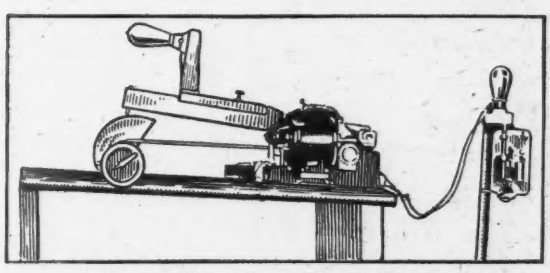


Fig. 5.—Mazda Lamp Testing Device.

which the filament breaks is indicated upon a dial by a pointer attached to the large cam. The result of a series of tests, described at a recent meeting of the Illuminating Engineering Society, comparing the old pressed-filament type with the drawn-wire lamp, was as follows:—

	25-watt lamp.	*60-watt lamp.*
Old pressed filament, distance lamp was dropped	0·06 in.	1·15 in.
Mazda drawn-wire filament, distance lamp was dropped	3·75 in.	A 4-in. fall failed to break filament.

A carbon lamp remained intact at the maximum fall.

Experience with Mazda drawn-wire lamps shows that the superiority of the drawn wire over the pressed filament is not confined to the early stages of the lamp's life, but that the drawn-wire filament is many times stronger than the old pressed filament at any time during its entire life.

The British Thomson-Houston Co., Ltd., have received a letter from the electrical engineer of a colliery stating that he tested the Mazda lamps by mounting them on a vibrating pit-head frame, and was highly satisfied with the result. Other reports state that of a consignment to Johannesburg of 1,200 lamps, not more than 1 per cent. were broken, and in another instance, where a batch arrived in a badly smashed-up case, only one lamp was broken.

Annual Dinner.—On November 18th, at Southall, Submersible & J-L Motors, Ltd., held their first Annual Dinner since the amalgamation of the two companies. Mr. B. T. Rumble (chairman of directors) presided, and Mr. T. L. Reed-Cooper (managing director) was in the vice-chair. After a few remarks from the chairman, Mr. C. F. Collins, representing the works, toasted the company. In responding, the Vice-Chairman outlined the successes of the "J-L" motors and dynamos, and referred to the trade done in them all over the world, especially in the Colonies. At home they had been fitted successfully to the largest lift contract on this side of the water. Government contracts were now in hand. Mr. C. K. Hickman (secretary) proposed the employés, and Mr. Whitehorn (designer) responded. A concert followed.

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BUSINESS NOTES.

Glover's Almanac.—The editor of this well-known and highly-appreciated almanac is at present inviting contributions of interest to electrical men for the 1912-1913 issue, which will be ready for circulation by June next. An advertisement stating fuller information appears in our pages to-day.

Water Purification Apparatus.—The Paterson Engineering Co., Ltd., of London, have received the following orders for their Paterson apparatus for electricity works :—

Aberdeen Corporation.—Standard type oil eliminator, with quartz filter of 5,000 gallons hourly capacity, capable of being readily extended to 10,000 gallons at a later date.

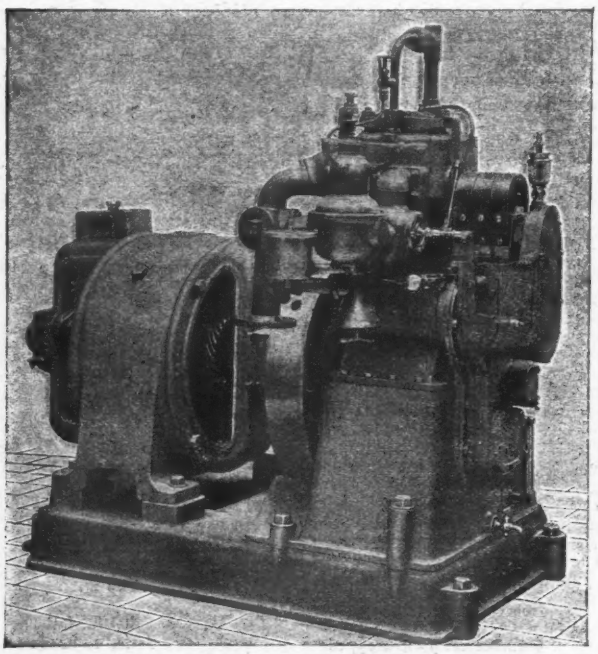
Kettering Corporation.—Oil eliminator, with quartz filter of 2,500 gallons hourly capacity, through Messrs. Aiton & Co. Consulting engineers, Messrs. Kennedy & Jenkin.

Barnes Electricity Works.—One oil eliminator and exhaust heater of 3,600 gallons hourly capacity.

Radcliffe Electricity Works, Lancs.—A cold process water-softener of 2,500 gallons hourly capacity. The water contains an exceptional amount of matter in suspension. This machine is fitted with the firm's quartz sand filter.

Lancashire Electric Power Co.—Two pressure quartz filters of 3,000 gallons hourly capacity, for purification of heavily contaminated water.

The Royal Train in India.—We understand that a special train has been built for the sole use of the King and Queen during all their journeys in India. In one of the cars there is an electric lighting plant, from which the whole of the cars composing the train will be lighted. The set consists of a 4·8-kw. 25-32-volt generator direct-coupled and mounted on a combination base to a paraffin engine. The marble switchboard panel for controlling this set consists of a combination generator and accumulator panel, which is equipped with the necessary instruments, rheostats, cut-outs, switches, and charging and discharging switch. The switchboard and the generator set were supplied by the British Thomson-Houston Co., Ltd., to Messrs. Turner, Hoare and Co., of Bombay.



B.T.-H. Paraffin Engine Set for the Royal Train.

British Electrical Success in New Zealand.—British Electrical manufacturers and traders have command of the electrical market (motors, lamp-ware, appliances, &c.) in New Zealand, and recognising the importance of this trade, American Vice-Consul-General Baker, who is on special service in New Zealand, has reported home concerning what he finds to be the reasons why British control is so marked. As, we believe, our firms will be interested in his views—which, by the way, are those furnished to him by the principal of a leading firm of electrical engineers there in response to questions—we print them :—

"As a rule, I find that for the same money better value is obtained in Great Britain, and the public taste seems to favour the British article when prices are the same ; but when going further into the merits and demerits of the manufactures of the two countries, the following three reasons make me prefer the British market when the home costs are the same :—

"1. The preferential Customs tariff at present in force treats American goods as being of foreign manufacture, and as a result the duty on them is 50 per cent. higher. As most electrical appliances bear a duty of 20 per cent. *ad valorem* on the invoice value (plus 10 per cent.), the American article costs 11 per cent. more for duty alone. This is a most important factor in quoting prices fine, and gives the British article a big lift.

"2. It has been my experience that before American houses will give a paying trade discount, arrangements have to be made to either send cash with order or take up a demand draft. The terms offered by competing British firms are much more liberal ; 60 and 90 days' sight are frequently given, and the receiver of the goods has a chance to turn them over before payment is actually made. On the American basis of business this is impossible.

"3. The time taken by American suppliers to effect delivery of an order is usually longer than that of British or even some European firms ; and the home charges are usually much heavier in America than in the British Isles.

"Complaints have been made to me by firms that have taken up American agencies that their principals sell direct to firms competing with their agents, granting the same discounts and terms to the outsider as would be given to the agent. Considering that the latter has, as a rule, to bear the cost of advertising, &c., it seems only just that he should be properly protected ; and full inquiries might be made by home firms before accepting direct orders. These are very frequently sent per medium of a home buying agent. I maintain that if an agent is expected to show a good return, all direct orders received from his district should be treated as though they had come through the ordinary channels. Unfortunately many firms, both British and American, do not see this matter in the same light, and as a result direct ordering is carried on to such an extent that some agencies are not worth having. I feel sure that in the long run it would pay home suppliers better by far if more attention were directed toward establishing properly protected agencies and less time devoted to the outside buyer."

Vice-Consul Baker tells his countrymen that as American manufacturers must contend with a preferential surtax of 50 per cent. of the duty on electrical appliances of other than British make, the only way they can succeed there is by offering goods of more attractive pattern and cheaper than the British goods, so as to offset the preferential surtax, and by being equally liberal in credit arrangements.

Turkey.—The American Chamber of Commerce recently founded a section at Salonika, Turkey. It already has one at Constantinople, but Salonika merchants will not accept sub-agencies of general agencies established in Constantinople.

Private Meetings.—Beck Flame Lamp, Ltd., Suffolk House, Laurence Pountney Hill, London, E.C.—In this matter, particulars of which appeared in a recent issue, the following are creditors :—

Deutsche Beck Bogenlamper (Ges.)	£51	Quitman Carl	£22
Annan Dexter & Co.	52	Automatic Standard Screw Co.	236
Middlesex Printing Co.	22	Gaspar & Co.	28
Uxbridge and District E.L. Co.	38	Highton & Son	64
Venner Time Switches, Ltd.	81	Pridey & Hale	20
Buchanan & Carwen	17	Hartjen, W., & Co.	16
Kelvin & James White	32	Vaughton Bros.	32
Heaton & Dugard	40	Allison Bros.	22
Lindley, C., & Co.	54	Harper, J., & Co.	36
London Electric Wire Co.	191	Shoolbred & Connell	61
Delta Metal Co.	60	Still, W., & Sons	32
Vons Co.	16	Haydn Harrison	98
Blume, C. H.	46	Corbett, S. D.	77
Jones, Price & Co.	16	Grant & Blake	32
Dalton & Morgan	28	Hatch, Geo.	18
Davis & Timmins	50	Argus Printing Co.	32
London Electric Firm	42	*Electrical Times*	32
		Price, E. C.	16

Bankruptcy Proceedings.—W. R. N. Gard, electrician, 65, Kingsley Avenue, West Ealing, late Orchard Electrical Works, Orchard Street, Canterbury. The following are among the creditors :—

Brock, A.	£50	MacQuaide, H. C.	£24
Braulik, G.	41	Court, Bros.	21
Service Co., Ltd.	27		

The first meeting of creditors was held on Monday, at the offices of the Official Receiver, 14, Bedford Row, W.C. The debtor's statement of accounts showed liabilities to unsecured creditors, £285, and the only asset disclosed is a surplus of £7 in respect of an organ held by a secured creditor to secure £8. Debtor attributes his failure to "want of capital and bad trade." It appears that he commenced business in June, 1903, at the Orchard Electrical Works, Canterbury, in partnership with another person. In November, 1905, the stock was sold, the book debts collected, and the debts paid in full, and the debtor then continued the business up to the end of October, 1906, when he came to London. He admits knowledge of his insolvency since July, 1906. At the date of the Receiving Order, two creditors had obtained judgment against the debtor. The furniture at the debtor's residence was stated to belong to his father-in-law, who lives with him. An order for summary administration having been made, the matter remains in the hands of the Official Receiver.

Arthur Parker, electrical engineer, of Yorkshire Street, Burnley.—On a creditor's petition a receiving order has been made at Burnley County Court. First meeting, December 7th, at Preston ; public examination, December 8th, at Burnley.

Charles Wallis, electrical engineer, Great Grimsby.—December 9th is the last day for receipt of proofs for dividend by Mr. J. F. Wintringham, St. Mary's Chambers, Great Grimsby.

For Sale.—As will be seen from another page of this issue, Messrs. Rhyrolle & Co., Ltd., of Hebburn-on-Tyne, are offering for sale, either as it stands or in parts, their D.C. switchboard which controlled the generators and supply to the

British section of the Turin Exhibition, and was awarded the Grand Prix.

MESSRS. P. HUDDLESTON & Co. will, on Thursday, December 7th, sell by auction at 16, Long Millgate, Manchester, a large quantity of electrical apparatus, fittings, and office effects. See our advertisement pages to-day.

Dissolutions and Liquidations. — COWPER-COLES ENGINEERING CO., LTD.—A meeting of creditors is called for December 5th, at the offices of W. B. Peat & Co., 11, Ironmonger Lane, E.C.

SOLIUM ELECTRICAL CO., LTD.—A meeting is called for January 12th, at 23, King Street, Nottingham, to hear an account of the winding-up from the liquidator, Mr. E. Harlow.

AUSTRALIAN ELECTRICAL CO., LTD.—A meeting will be held on January 3rd, at 20, Copthall Avenue, London, E.C., to hear an account of the winding-up from the liquidator, Mr. E. Pears.

MINERS' SAFETY LAMP AND ACCESSORIES CO., LTD.—A meeting is called by the liquidator, Mr. T. L. Judd, for December 30th, at 57, Gracechurch Street, E.C.

TORQUAY TRAMWAYS CONSTRUCTION SYNDICATE, LTD.—This company is winding-up voluntarily, with Mr. L. B. Schlesinger and Mr. W. B. Cownie as liquidators. A meeting of creditors is called for December 6th, at 3, Laurence Pountney Hill, E.C.

J. E. ELLIOTT & Co., electrical engineers, 12, Broad Street, Oxford.—Messrs. H. J. Bradley, H. S. Kingerlee, J. E. Elliott and J. D. Elliott have dissolved partnership. Messrs. J. E. and J. D. Elliott will attend to debts, &c.

A Sydney Exhibition.—The New South Wales Legislative Assembly is conferring with the other State Governments regarding the holding of an international exhibition at Sydney, at a cost of £100,000, the object being to bring the potentialities of Australia under the notice of the world.

Book Notices.—"Engineering Standards Committee: Report No. 55.—Experiments on Hard-Drawn Copper and Bronze Wire." London: Crosby Lockwood. Price 10s. 6d. net.—The General Post Office and the National Telephone Co., the two largest users of telegraph and telephone wire in the country, having provided certain funds for the purpose, experiments have been carried out for the Engineering Standards Committee by the National Physical Laboratory, with a view of obtaining some independent data with regard to the breaking stress of hard-drawn wire of small diameter, used for telegraph and telephone purposes. The experiments described have covered a wide ground and include investigation into the variation of mechanical properties of these wires due to difference of make, variation in diameter, length and temperature, as well as variation in strength due to the kinking of the wire, which apparently has a more considerable influence on the strength of the wire than has hitherto been appreciated. This class of wire should be wound on coils of larger diameter than is usually the case in order to minimise this defect.

"The Principles and Practice of Electric Wiring." By A. Bursil. 1911. London: Longmans, Green & Co. Price 3s. net.

"Revolving Vectors." By George W. Patterson. 1911. London: Macmillan & Co. Price 4s. 6d. net.

"Journal of the Western Society of Engineers." Vol. XVI, No. 7. September, 1911. Chicago: The Society. Price 50 cents.

Cooking by Electricity.—OLYMPIA AWARD.—Visitors to the Olympia Electrical Exhibition will learn with interest that the first prize in the Olympia competition for kitchen equipment was won with a "Tricity" outfit by Mrs. Miller, of Chislehurst. Mr. Grogan was also awarded a prize for his "Tricity" essay.

Catalogues and Lists.—THE ELECTRICAL CO., LTD., 122-124, Charing Cross Road, London, W.C.—Price list of "Plania" flame carbons for various purposes; also a leaflet of D.C. motors in stock.

MESSRS. C. WHITTAKER & Co., LTD., Union Foundry, Haslingden.—Several illustrated lists relating to their manufactures. One describes the improved "Sun" type of propeller fan, with a table of speeds, volumes, and powers of standard sizes, and gives sections showing positions of pulleys, and states prices. The second ("B"), describes centrifugal fans in sheet-steel cases, also giving a table of diameters, speeds, B.H.P.s, &c. Lists "C" and "E," particularise Tattersall's "thin stream" heaters or coolers; List "D" contains a full description of the Tattersall multiple effect condenser or cooler, which is a combination of surface condensing by air with evaporative cooling; this is claimed to be a highly efficient and convenient system of condensing steam entirely by air in place of water.

MESSRS. SCHOLEY & Co., LTD., 151, Queen Victoria Street, London, E.C.—This is a 20-page catalogue of alternating-current motors. It is got up in superior style with excellent half-tone views on art paper of slip-ring and squirrel-cage motors, including totally enclosed slip-ring motors for colliery work showing inspection cover open and closed. A general description of the motors is followed by tabulated powers, speeds, and prices of two and three-phase squirrel-cage and slip-ring motors, also single-phase squirrel-cage and slip-ring rotors of several types. Other tabular matter details efficiencies and power factors, dimensions, and approximate weights and shipping particulars.

THE KORFUND CO., 47, Victoria Street, Westminster, London, S.W.—Twelve-page pamphlet giving a good deal of illustrated information regarding "Korfund" patent impregnated cork resilient plates for insulating the foundations of stationary machines, &c., minimising or absorbing vibration or noise arising therefrom. The Korfund Co. has taken over the business of the Genest-Stoessel Insulating Co. for the supply of these plates.

THE ADNIL ELECTRIC CO., LTD., Adnil Building, Artillery Lane, London, E.C.—New circular (AE 52) containing a brief description of their metallic-filament lamp fitting for indirect lighting for use in workshops and factories, large offices, schools, drawing offices, &c. Prices and details are tabulated.

MESSRS. DAVIDSON & Co., LTD., Sirocco Engineering Works, Belfast.—Two folders in the form of "Sirocco" centrifugal fans. In opening one the cover of the fan is removed, while the other contains a series of small half-tone views showing the fans employed in various classes of work.

Trade Announcements. — MESSRS. SUBMERSIBLE MOTORS, LTD., of 23, St. Swithin's Lane, E.C., have taken over the works and business of the J. L. Manufacturing Co., Ltd., of Johnson Street, Southall, Middlesex, as from August 11th, 1911, and all liabilities since incurred, and book debts, will be met by them. It is intended to shortly alter the name to "Submersible & J. L. Motors, Ltd." as stated in our last issue. The manufacture of the laminated field "J. L." motors and dynamos will be continued, and the plant used in their production is being extended, and the manufacture of "Macdonald" submersible motors is also to be transferred to Southall.

THE POLYSTAT ELECTRIC CO. have removed from 5, Kelvin Avenue, to 226, Marsland Road, Sale, near Manchester.

MR. HORACE SLOMAN, electrical engineer, will in future carry on business at 56, Leigh Road, Westcliff-on-Sea.

THE BRITISH CENTRAL ELECTRICAL CO., of Hatton Garden, have added a new telephone line, and their numbers are now "City 9498" and "Central 1218."

THE BRITANNIA RUBBER AND KAMPTULICON CO., LTD., are removing to more central premises, and on and after December 1st next their address will be 7, Newgate Street, E.C.

MR. JOHN D. MACKENZIE, 217, West George Street, Glasgow, has been appointed sole Scottish agent for Messrs. Sykes & Sugden, Ltd., Huddersfield, manufacturers of service fuses, joint boxes, feeder pillars, &c.

MR. H. R. WITTING will, from December 8th, transfer his offices to more extensive premises at 41, Berners Street, London, W.

Osram v. Motor-'Bus.—We have received a further testimony to the strength of the Osram filament. In this case it was very strikingly demonstrated, for in a recent collision between a motor-'bus and a lamp standard in the West End of London, the lantern was completely buckled, and in a picture that is before us it appears making its obeisance in most abject manner—it is considerably more than half-seas-over. Nevertheless, the Osram lamp itself, with that stolid indifference to surroundings that has so often characterised other members of the same family, remained intact, and lit up instantly in response to the switching on of the current.

Fire.—A correspondent says that valuable machinery, electrical power fittings, laboratory apparatus, &c., were destroyed by fire last week at Musselburgh Wire Works (Messrs. W. N. Brunton and Son).

Chile.—An American Consul draws attention to the good openings in mining and industrial pursuits in Chile that are worthy of investigation. The Government is anxious to develop the natural resources, and capital can be profitably invested. A decree has been issued by the Minister of Public Works reserving sufficient water power to generate electricity in the event of the present plans for electrifying the Government railways being carried out.

All-German.—An American Consul in Germany states that Der Alldeutscher Verband (The All-German Union) has issued a circular, copies of which have been transmitted to all principal business men, calling upon the German people in general, and the business men in particular, to favour home interests wherever possible. In German business houses and factories only Germans should be employed; commercial correspondence with foreign countries should be in all instances in German; German products should be given German names; and German retailers should always recommend the articles of home production carried by them before calling attention to those of foreign make.

LIGHTING and POWER NOTES.

Abingdon.—While the T.C. has given notice of its intention to apply for a provisional order to supply electric power and light, no scheme will be taken up until the reports of the special committee and of the expert consulted have been laid before the Council. The Council has retained the services of Messrs. Lacey & Sillar, consulting engineers]

Aldeburgh.—A B. of T. inquiry was held on November 22nd relative to objections to proposed works to be established by the Electric Supply Co., Ltd. Mr. Christie, of Messrs. Christie Bros., of Chelmsford, said that the proposed plant would not cause any noise or vibration to the annoyance of residents. The nearest house was 60 or 70 yds. from the site of the generating station, and the exhaust would be absolutely silent at 20 or 30 yds. away. He also fully met other objections put forward.

Australia.—The North Sydney Electric Lighting Bill has again been discussed by the Council; an opinion was given that the Council could not legally farm out the electricity supply. It was estimated that the cost of the undertaking would be £75,000, and this sum, it was stated, was beyond the power of the Council.

The Railway Department contemplates spending £20,000 on additional electrical plant in connection with the Melbourne goods yards and sheds.

Axbridge.—The R.D.C. has consented to the application of the Winscombe E.L. Co. for powers to supply current to the parishes of Banwell, Sandford, Churchill, Cross, Axbridge and Cheddar.

Aylesbury.—The U.D.C. has decided to go into the electric light question with a view to a prov. order being applied for. A private person has offered to give a site for the generating station, and to defray the expenses of obtaining the order.

Biddulph.—A special meeting of the U.D.C. has decided by 10 votes to 2 to apply for a prov. order authorising a supply of electricity within the district. According to a draft agreement before the meeting, Messrs. Heath will supply electricity at the rate of 1½d. per unit, less discount according to quantity, for a certain number of years, and if not terminated then, to be subject to notice on either side.

Blackpool.—As a result of experiments with the "Metrofiam" arc lamp, it has been decided to put up another 10 of these lamps on the widened promenade.

Brazil.—The *Financial News* says that cable advice received in London from Rio de Janeiro, states that the petition presented by Messrs. Guinle to Congress for a concession for the distribution of electricity in the City of Rio de Janeiro has been rejected by a large majority.

Brighton.—By a large majority the T.C., on November 23rd, rejected the recommendation (referred to in the ELECTRICAL REVIEW last week) to support the Bill of the I.M.E.A. seeking powers to enable local authorities to provide and fix wiring and fittings in consumers' premises. It will be remembered that the engineer advised that such work was best left to private enterprise.

Burnham (Somerset).—The U.D.C. has definitely decided to apply to the B. of T. for a prov. order for E.L.

Buxton.—The U.D.C. has decided to ascertain whether the B. of T. will amend the E.L. Order giving the Council power to hire out stoves, &c.

An Electrical Exhibition has been arranged to be held from December 4th to 9th; 12 firms have promised to send exhibits.

Canada.—Sir Max Aitken is organising a merger of the various sources of power on the Upper St. Lawrence River, the capital involved being £20,000,000. Some existing concerns will be taken over by the new company, which will develop sufficient power to supply the needs of Eastern Ontario and Western Quebec for some years.

Carnarvon.—The T.C. is still in a state of uncertainty as to whether to light the principal streets of the town by electricity or not, though the matter has been under consideration for more than 12 months. At a special meeting of the Council in September, it was agreed to adopt a scheme of electric lighting for some parts of of the town, the annual cost to the ratepayers not to exceed £100. A member of the Council has since given notice to move that the resolution be rescinded, and the proposal will be discussed at the next meeting of the Council. Much interest is being taken in the matter by the ratepayers.

Crewe.—An inquiry has been held by the L.G.B., relative to the application of the Corporation for sanction to borrow £3,602 for electricity purposes. Of the amount named, £1,000 is required for an additional boiler and fittings; £550 for a new main in Wistaston Road to the Webb Orphanage and Cottage Hospital; £825 for a main to supply the new postal sorting office and new training college; £375 for mains extensions in High Street and Market Street; and £500 for general extensions to mains (public lighting, house services, &c.). It was stated that the postal authorities and the County Council had agreed to pay for current at the same rates as in Crewe.

Croydon.—The L.G.B. has sanctioned an expenditure of £9,500 for extension of mains. The application for power to borrow £500 for transformers having been withdrawn at the public inquiry (on the suggestion of the Inspector), such expense is in future to be taken from revenue. For dealing satisfactorily with the increasing output of the undertaking, the Committee obtained the consent of the B.C. on Monday last, to taking £5,150 from the reserve and renewals fund for 2,000-volt and 5,000-volt switchboards, and the necessary alterations for fixing same. The vice-chairman said the fund stood at £35,000, so that this expense would still leave the undertaking in a strong financial position. The borough electrical engineer (Mr. A. C. Cramb) reported that between October 12th and November 16th there were 114 new applications for current, equivalent to 3,715 8-C.P. lamps.

Darlington.—On Tuesday, Mr. R. H. Bicknell held a L.G.B. inquiry into an application of the T.C. for £3,200 for the provision of additional generating plant at the Houghton Road electricity works.

Dundee.—The Electricity Committee has agreed, on the recommendation of Mr. Harry Richardson, the engineer, to support the Bill promoted by the I.M.E.A., in which further powers are sought for public electrical undertakings. Mr. Richardson explained that the cost of the Bill would be apportioned according to the revenues of the several corporations benefiting by it, and that Dundee's share would not at the most exceed £120. Mr. Richardson described as incongruous the position of the electricity department compared with the gas undertaking, which had unlimited powers, even power to manufacture gas appliances. The convener—Mr. J. M. Nairn—said that the work done by local contractors during the last four years amounted to £13,000, while £36,000 worth of work had been done by firms outside the city. When the matter had been brought up before, the local contractors had made made a great song about the business they would lose, but it could be shown that at present they were not doing a third of the business of the city. The Committee was unanimous in its decision.

Durham.—An electrical installation has been put in at Twizell Colliery, Beamish, Durham, belonging to Messrs. James Joicey & Co., to drive the fan, a pump, the haulage and the screens, by Messrs. Siemens Bros. Dynamo Works, Ltd. Three-phase current is supplied by the Durham and Cleveland Electric Supply Co. The western group of collieries owned by Messrs. Joicey, of which Twizell forms one, produces about 9,000 tons of coal per day, and Twizell is the first to be electrified.

East Barnet Valley.—At the last meeting of the U.D.C., it was decided, in accordance with Sec. 6 of the North Metropolitan Electric Power Supply Act, 1909, that consent should be given to the North Metropolitan Electric Power Supply Co. to supply energy within the East Barnet District, upon the understanding that the company submitted for consideration by the Council, and got its approval of, a definite area of the district to be supplied with electricity within a period of two years. It was further decided that under no circumstances would the company be allowed to place a kiosk on the public highway.

Falkirk.—At a meeting of the T.C. a report was submitted as to the present and prospective load at the electricity station and as to the necessity of further extending the works. The engineer was asked to report on the matter. It was agreed to adopt the Metrofiam lamp for lighting at Camelon.

Great Harwood.—The question of gas lighting cropped up at the meeting of the Council on November 22nd, when Mr. J. E. Allsopp called attention to what he described as the miserable gas illumination. It looked as if the town was being lighted up with farthing candles. The chairman also criticised the gas lighting, and said he was pestered with complaints from people. But he was inclined to think matters were not so bad in Accrington itself as at Great Harwood, or they would have heard about it

Helsby.—The P.C. has decided to substitute an electric motor for a gas engine at the waterworks, for driving the pumps.

Hoyland (near Barnsley).—For some time the Council has had under consideration the question of the introduction of electricity into the district. The matter was brought to the forefront by an application from the Electrical Distribution of Yorkshire, Ltd., asking for permission to come into the township, and for the support of the U.D.C. in its application for the necessary prov. order. The question has again been considered, and at a specially convened meeting it was decided that the Council itself should apply for an order to supply electricity in the township.

Hornsey.—At the last meeting of the B.C., it was decided to appoint a lady canvasser for the electricity department, at a salary of £1 per week, with an additional payment of 10s. for each consumer obtained. Replying to various statements made in the discussion which ensued, Councillor Moritz said that a canvasser was a serious necessity. Frequently they had received applications for an extension of cable, which would be unremunerative unless two or more additional consumers could be secured, and it was usual to canvass the road, and according to the experience of business men, that could be done better by a woman than by a man. As an experiment the Committee desired to see whether they could not get better results from a lady canvasser than could be obtained in the case of a man.

Launceston.—The Launceston and District Supply Co. proposes applying for a provisional order to authorise it to supply electricity for public and private purposes within the borough.

Linlithgow.—At a meeting of the T.C., a communication was read from a firm of Edinburgh agents transmitting a proof of the draft of the Linlithgow and District Electric Lighting Order, under which it is proposed to introduce electric lighting to an area to include the burghs of Linlithgow, Bathgate and Armadale, and the parishes of Linlithgow, Bo'ness and Carriden, Bathgate and Torphichen, in the county, except the parts of Bo'ness and Carriden,

which are situated within the municipal boundary of Bo'ness. Without expressing any definite pronouncement on the scheme, the T.C. instructed the Town Clerk to ask why the promoters of the order only proposed to carry their distributing plant along the High Street, for a distance of little more than one-fourth of a mile.

India.—The *Times of India* of November 4th states that the Mysore Durbar has sanctioned a large scheme for the extension of the River Cauvery hydro-electric and irrigation works, and the execution of the first stage of the scheme was to be begun immediately. The full project, estimated to cost about £1,687,000, includes, besides hydraulic works, extensions and improvements of the Cauvery power works to provide additional power to the extent of 5,000 H.P.

Llandudno.—The electrical engineer has been requested to furnish plans and particulars of the proposed additional promenade lighting, so that application may be made without delay to the L.G.B. for sanction to the required loan.

London.—The Workhouse and Infirmary Management and Visiting Committee of the City of London Guardians has decided to carry out by direct labour the installation of electric light in the chapel and dining hall, at a cost of £25, owing to the incandescent gas lighting not being satisfactory. By doing this, the Committee states a saving of 2s. 7½d. per quarter on each burner, during the winter months, would be effected.

HAMMERSMITH.—Application is to be made to the L.C.C. to advance the sum of £10,000 as the first instalment of the loan of £23,775 sanctioned by it for electricity purposes.

Mansfield.—The T.C. has applied to the L.G.B. for loans of £500 for meters and £3,500 for works in connection with the supply of current to Mansfield Woodhouse, where the terms to consumers will be a flat rate of 4½d. per unit.

New Malden.—The U.D.C. has decided to have the municipal offices, fire station and mortuary lighted by electricity, at an estimated cost of £150.

Manchester.—The Electricity Committee has accepted the tender of Messrs. J. Howden & Co., for a 4,500-KW. exhaust turbine with Siemens alternator, and barometric condensing plant by Messrs. Mirrlees Watson. The turbine set will be run from exhaust steam supplied from five Yates & Thom reciprocating sets.

A deputation which had been on the Continent to inspect turbo-alternators, was much impressed with the possibilities of using in the future large power internal combustion engines.

Newton (Lancs.).—The U.D.C. has decided to make application to the B. of T. for a provisional order to supply electrical energy. It was stated that the provision of electricity by an outside authority would in time seriously compete with the gas undertaking, and it was thought the Council should see if there was a demand sufficient to warrant the local authority embarking upon a scheme. At the present time the Council was in communication with probable large consumers, and hoped to supply the works with current at a low cost.

North Berwick.—The T.C. has agreed to an extension by six months of the period allowed for forming a company in connection with the introduction of electric lighting into North Berwick. It is anticipated that negotiations will be completed within the next three or four months.

Portsmouth.—The Finance Committee of the T.C. has decided to offer no objection to the proposal of the Electricity Committee to apply for powers to wire houses and charge the owners on the hire-purchase system or a rental, on the same lines as the gas company.

Rawtenstall.—It has been resolved to withdraw the application to borrow £2,000 for the lighting of the streets by electricity, but it has been decided to light Bacup Road from Queen's Square to Waterfoot by electricity, as well as Band Street from the central fire station to the railway station, the cost of the reduced scheme to be provided out of current revenue. Central lighting will be adopted, the lamps being suspended in the middle of the road.

Redditch.—On November 24th a L.G.B. inquiry was held into the application of the U.D.C. for a loan of £5,850 for electricity purposes. There was no opposition.

Sheffield.—A L.G.B. inquiry is to be held on December 7th into the application of the T.C. for a loan of £61,099 for extensions at the Neepsend generating station.

Slough.—There has been a remarkable growth in the demand for electricity in the districts of Slough and Windsor. At Gotha Works, Slough, Messrs. Peters & Co. have installed electric motors of over 200 H.P. to replace a steam plant, and all the premises are being lit by electricity. At Windsor the sewage works are fitted with a pumping installation; electric motors have been installed in the Royal Gardens, Frogmore, to assist the hot-water circulation in the many glass houses, and the buildings are being lighted by the same means, while at the Royal Mews, upwards of 500 electric lamps are being fitted. Several of the larger local institutions are also adopting electricity.

South Africa.—Mr. Bellad Ellis has lately been appointed electrical engineer to the Municipality of Queenstown (Cape Colony) where an electric light plant is just about to be put down. The plant is to consist of two 100-H.P. Diesel engines direct-coupled to 70-KW. D.C. generators for 220-440 volts. The distribution will be on the three-wire system, with underground feeders and overhead lines erected on steel poles, approximately 520 in number. The street lighting will be carried out with 200-C.P. metal lamps for the main street, 16 in number, and 50-C.P. metal lamps for the side streets, 200 in number. Power is to be available during the 24 hours, and at times of light load a Tudor battery of 258 cells will meet the demand as well as on the peak of the load. A balancer and battery booster are also to be included in the plant. Already 100 consumers have agreed to take a supply, which it is hoped will be available by July, 1912.

EAST LONDON.—Mr. E. J. Evans has just carried out the electric light installation of the Vaudette Theatre, of this town; it consists of four flame arc lamps of approximately 2,000 C.P. outside, and interior lighting of the theatre and stage up to 7,640 C.P. in small lamps, also a motor-generator for the bioscope arc lamp, and two large electric ventilating fans. The same firm are about to install two 2,000-lb. Waygood electric lifts in the large wool store of Messrs. Mosenthal & Co.

South Wales.—Provisional orders for electric light for the districts of Llantwit-Fardre, Llantrisant, Bedwas and Machen Upper are being applied for by the South Wales Electrical Power Distribution Co.

Swinton (near Manchester).—The application of the Swinton and Pendlebury U.D.C., for sanction to borrow £4,000 for electricity purposes, has been the subject of an inquiry by the L.G.B. The amount was made up as follows:—£2,198 expenditure in excess of loan; £1,600 for mains and services; £100 for meters; and £102 for contingencies, but this amount was subsequently reduced by £677—£600 in respect of mains and £77 for contingencies—leaving the net amount applied for as £3,323. No opposition was raised at the inquiry.

Tasmania.—It is reported that the Complex Ores Co. has deposited £1,000 in favour of the Hobart Council, in accordance with its contract to supply electricity by December, 1912. The company is developing power at Great Lake, and intends to produce carbide, and establish metallurgical works.

Tingael.—Efforts are being made to secure a supply of electricity for this parish, and a private company has sought the assent of the Camelford R.D.C., which has referred the matter to the Parish Council.

U.S.A.—The first of three 20,000-KW. turbo-alternators which are being installed at the Waterside Station No. 1 of the New York Edison Co., was officially started up on November 3rd. These sets consist of six-stage Curtis vertical turbines coupled to four-pole, there-phase, 25-cycle, 6,600-volt alternators, and operate on 175-lb. pressure steam, superheated 100°. The machines are 17 ft. 6 in. diameter and stand 37 ft. high above the base. It is interesting to note that the floor area taken by one of these sets is 297 sq. ft., while the area taken up by one of the 3,500-KW. engine units which have been displaced was 918 sq. ft. The steam consumption guaranteed is at 10,000-KW. load, 15 lb. per KW.-hour, at 15,000 KW., 14·4 lb., and at 20,000 KW., 15 lb. per KW.-hour. It will be remembered that we described a Chicago station a few weeks back, in which similar size units are being installed.

Uruguay.—A Government Bill has been introduced for the nationalisation of electricity supply throughout the country. It is proposed to redeem existing concessions by an issue of 5 per cent. bonds, amounting to a million sterling.

West Ham.—Mr. H. H. Couzens, electrical engineer, reports that it is absolutely essential in order to have a proper reserve that further boiler plant should be installed. He had accordingly approached Messrs. Babcock & Wilcox (whose tender was recently accepted for two boilers, each evaporating 37,500 lb., with economisers and other auxiliaries, at £9,790), to see whether they could anticipate delivery. They were unable to promise less than three months delivery for one boiler, but offered two alternatives:—(1) one boiler with economisers and auxiliaries evaporating 25,000 lb. per hour at £3,500; and (2) two boilers to evaporate 36,000 lb. per hour at £4,700, with a guarantee that both offers should be complete, ready for steaming, by December 28th, provided the order was placed immediately. As an alternative, he had approached Messrs. Clarke, Chapman & Co., who had offered a boiler of 26,500 lb. evaporation, with economisers and auxiliaries, at £3,540, to be delivered at the end of the second week in January. The engineer recommended that the tender of Messrs. Babcock and Wilcox for the two boilers should be accepted at £4,700. The engineer further reported that in addition to the amount of Messrs. Babcock & Wilcox's tender, there were certain motors to be provided for driving auxiliary plant, &c., and recommended that application be made to the L.G.B. for the borrowing of £5,500. These recommendations were agreed to by the Electric Lighting and Tramways Committee. Sanction has been received from the L.G.B. to the borrowing of £3,100 for extensions of mains in the Stratford district.

Worcester.—The T.C. has decided to apply to the L.G.B. for a loan of £1,675, in connection with the electrical pumping plant at the waterworks. An additional main, to cost £1,400, will be necessary.

Worsley.—It is understood that the D.C. here contemplates lighting with electricity certain portions of its township and has communicated with the Lancashire Electric Power Co.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The Corporation Tramways Committee, on Monday, agreed to alter the car trucks by lengthening the wheel base from 6 ft. to 7 ft., in order to strengthen and steady the cars and reduce rocking to a minimum. The work will be undertaken gradually in the Corporation's own workshops, by men employed by the department, during the next two years. A letter was received from the B. of T. agreeing to the "speeding up" of the cars to the maximum rate proposed.

Argentina.—The directors of the Compania Anglo-Argentina de Electricidad, following the programme laid down of steadily extending the sphere of influence of the company, have acquired all the shares of the Compania Luz y Tranvias del Norte, in the city of Salta, and also the use of water power of the rivers Toro and Corralito, in the same province. Construction work on the tramway is well in hand, and the first section will be opened in a few months.—*Review of the River Plate.*

Australia.—Two accountants, appointed by the Victorian Government to investigate the accounts of the Railways Department, have reported that the suburban lines are operating at a profit, which last year, according to their basis of reckoning, amounted to £33,000. The Commissioners considered that these lines were run at a considerable loss.

Baildon (Yorks.).—A proposal to ask the Bradford City Council to state on what terms it would be prepared to extend the tramway from Baildon Bridge to the Bay Horse Hotel, at Baildon, led to a long and lively discussion at a meeting of the Baildon D.C. last week. The resolution in favour of approaching Bradford was, however, eventually carried.

Blackpool.—The T.C. on November 23rd decided to invite tenders for repaving the tramway track from Queen's Square to the Gynn. Application is to be made to the L.G.B. for sanction to borrow £4,200 to cover the cost of the six new cars just ordered, which are to be ready for Easter, and also the cost of proposed extensions at the Blundell Street depot for the accommodation of machinery for carrying out repairs on the premises.

Bradford.—The manager of the city tramways, Mr. C. J. Spencer, has been instructed to prepare a comprehensive report on halfpenny fares, workmen's return fares, tramway tickets and passes.

Continental Notes.—AUSTRIA.—The Imperial Railway Department has been engaged for a considerable time past in studying the question of electrifying various sections of the railway network. The Salzkammergut section from Attnang to Steinach will take precedence for treatment, and it is stated that the firm of Stern & Haferl are about tendering to the Department for the supply of current from the Gosau station. The inquiries of the Railway Department have shown that electric driving will not cost more than the existing motive power. The particular section which the Railway Department has had under consideration has an extent of 140 km., and it has been decided to employ electric locomotives for the main line traffic, but motor carriages will be employed in other localities.

An electric railway, 23·5 km. in length, to cost 2,300,000 kronen, is to be built starting from Baden and running to Klausen Leopoldsdorf, in Lower Austria, the concession has already received official sanction. Suburban electric railways are also projected at Grosswardein and Grad, in the Estergom district, while the T.C. of Tata have ordered the preliminary studies for the introduction of electric tramways to be undertaken.—*Der Elektrotechniker.*

GERMANY.—As a result of the successful adoption of electric traction on the Dessau-Bitterfeld line, on the A.E.G. alternating-current system, the Prussian State Railway authorities have decided to similarly "electrify" the Madgeburg-Leipzig-Halle (106 miles) and the Lauban-Konigszeit lines (150 miles).

Croydon.—The tramway manager (Mr. T. B. Goodyer) had been instructed to accelerate the speed of the cars, and report any practical difficulties found in that direction.

Dundee.—The Corporation Tramways Sub-Committee has accepted the offer of the Railless Electric Traction Co. for two vehicles at £700 each. They are to be run on the Clepington Road between Maryfield and Strathmartine Road. The town clerk, at a meeting of the Tramway Committee, reported the receipt of letters from the North British and Caledonian Railway Companies setting forth that it appeared from notices in the Press that the T.C. was to initiate a trackless car system in Clepington Road without having obtained the necessary powers from Parliament. The companies objected, and if the announcement made was correct, they would be glad to hear that the proposal was to be abandoned, otherwise they had no alternative but to take action in the matter. The town clerk, in reply, pointed out that the letters must have been written in ignorance of Sec. 50 of the Dundee Corporation Order of 1907, which gave the Council power to adopt that system of traction. The consent of the B. of T. had been obtained. He (the town clerk) was afraid the companies could not now object, and the Corporation had no intention of abandoning the new system. The Committee approved of the town clerk's reply.

Glasgow.—Confirmation of the proposal to double the present ½d. stage for the same fare, has not yet received the final sanction of the T.C. The parent Committee has met, but without disapproving of the proposed experiment—which will extend for three months—remitted the question back for further information. The matter must again come before the Committee this week, and will not be decided by the Corporation—which is already committed to the principle—until December 7th.

Lanarkshire.—The County Council of Lanark has published a draft of the proposed provisional order under which it seeks to lay down, and work electrically, several tramway routes within its jurisdiction. The first route, which extends six miles, commences with a junction with the tramways belonging to the Corporation of Glasgow, near Uddingston, and passing thence to Holytown *via* Thorniewood, Bellshill, &c. The second tramway, which will be two miles long, commences with a junction with the Lanarkshire Tramways Co.'s line in Main Street, Uddingston, linking up the first line on the road from Glasgow and Bellshill and the thoroughfare from Glasgow to Holytown. The third tramway will commence with a junction with tramway No. 1 in Main Street, Mossend, and proceed *via* the Calder and other roads by Milnwood and terminate at New Stevenston.

Lancaster.—At the yearly meeting of the Lancaster and District Tramways Co., Ltd., the report showed a profit, after paying interest on loans, of £589. The income had increased, and expenditure decreased. The chairman said they could not expect a much better return with the present horse traction system, which cost 1s. 1d. per mile, and the directors would seriously consider, in the immediate future, the question of electrical or petrol traction.

Liverpool.—The Tramways Committee, on November 24th, discussed are solution calling for the immediate reinstatement to the same grade, and at the same rate of pay of the tramway men who came out during the August labour troubles. The general manager reported that the number of men still out was 67, all but 15 of whom were in some kind of temporary employment. During the debate that ensued, it was generally agreed that the men would eventually be reinstated. The resolution only received seven supporters, and was defeated by a large majority.

London.—HAMMERSMITH.—A letter has been received from the B. of T. to the effect that it had appointed Mr. W. Worby Beaumont, of the Outer Temple, as referee to settle the difference between the Borough Council and the London United Tramways, Ltd., with respect to the condition and repair of the track and rails of certain tramways belonging to the company.

Tynemouth.—At a meeting of the T.C. on November 22nd, a report from the Council in committee was approved for the construction by the Tynemouth Electric Traction Co., Ltd., of a railless trolley system from the Town Hall, North Shields, to Preston Village. The company had been approached by a deputation, who made a request for the system, and the company agreed, on condition that the Corporation consented to the consolidation of the dates of purchase for the existing tramways and light railways in its area, so that the right of purchase should be the same all round—that is, 21 years from the granting of the order for the railless trolley system. The company also asked for a flat rate of 1d. per unit for all current used, and laid down other conditions as to route, but in the event of the electric 'buses taking 10d. per 'bus-mile during a 12 months' trial, the company undertook to construct a circular route which was proposed. The Council, in its proposals, agreed as to the consolidation of the dates as to rights of purchase, but suggested that the charges for power for the existing tramways should remain as at present, and the company be charged 1d. per unit for the railless system, and that the company should construct a complete circular route. It is understood that these modified terms are under consideration by the company.

TELEGRAPH and TELEPHONE NOTES.

Imperial Cables.—An interesting lecture upon "The Atlantic Cable Position and its Moral" was given by Mr. Charles Bright, F.R.S.E., M.I.C.E., at the London Chamber of Commerce, on Wednesday afternoon last, Lord Desborough, K.C.V.O., in the chair. The lecturer noted the various suggestions he made in a lecture delivered before the Chamber in 1902, when he addressed it in connection with the all-British Pacific cable. Since then the *personnel* of the various Government departments concerned has undergone frequent change, but little real progress has been made. The principal reforms have been the diversion of part of the land-line in America from the State of Maine to Canada, and the decision to charge reduced rates for deferred messages.

On the other hand, the general position has undergone a distinct change for the worse. The absorption of the Western Union Telegraph Co. by the American Telephone and Telegraph Co., and the subsequent action taken with regard to landlines in America, placed the English-owned cables in a very difficult position. They have extricated themselves on favourable terms to their shareholders by an arrangement which practically places the control of the cable in American hands, and this arrangement only awaits the sanction of the Imperial Government with reference to the transfer of the landing licence to become operative.

The trans-Atlantic link in the scheme for All-British cables to all parts of the Empire thus passes under foreign control. The

lecturer showed that this was a serious menace to Imperial interests, and urged the provision of duplicate cables, laid along different routes between this country and Canada, Halifax, in Nova Scotia, being the Canadian terminus. New landlines across Canada would be required to secure complete immunity from foreign risks for the Pacific Cable. A British-owned cable already connects the West Indies with Halifax *via* Bermuda. A further connection between this system and Gibraltar *via* Bathurst would give an entirely British line to the Cape, and link up the principal parts of our Empire.

The lecturer concluded by urging that the essential features of the scheme would cost less than one Dreadnought, and that in view of the strategic value of the proposal it would be a suitable subject for inclusion in the Naval Estimates.

Mr. Bright was heartily thanked for his lecture, and the following resolution was unanimously passed :—

"That, in view of the facts revealed in Mr. Bright's address, representations be made to His Majesty's Government, urging, for National and Imperial reasons, that—

"1. The licences formerly granted to British Atlantic companies be not transferred to any foreign corporation.

"2. If, however, such licences be transferred, seeing that this will involve the control of all trans-Atlantic cables between the United Kingdom and Canada being in foreign hands, it be strongly urged that His Majesty's Government should co-operate with the Governments of our Dominions—and especially with Canada—for the establishment of an independent and strictly 'All-British' trans-Atlantic cable and landline connecting with the Imperial Pacific Cable ; that this should be in duplicate (on different routes) if possible, and worked on a low-rate basis.

"3. It is further urged, on National and Imperial grounds, that the latter course should, in any case, be pursued, but especially if the said licences are transferred—even if favourable terms are thereby secured."

Brazil.—The action brought by the Western Telegraph Co. against the Government for the cancellation of the decree authorising Mr. Reidy to lay submarine cables along the Brazilian coast has been dismissed. The Judge held that the decree only implied an authorisation, and it had not been put into execution.

Japan.—Negotiations are in progress between the Japanese Department of Communication and the Danish Great Northern Telegraph Co., for the purchase by the Government of the cable service between Nagasaki and Shanghai and between Nagasaki and Vladivostock.

Manitoba.—The operation of the Manitoba Government telephone system for the year 1911 will show a loss of nearly £30,000. The Commissioners managing the system will recommend to the Government a number of radical changes bearing upon the matter of rates. There are 200,000 telephone users in Manitoba.

Norway. — Officials from the telegraph and telephone administration are visiting Continental capitals with the object of studying various telephone systems, as the telephone service of Christiania, which is now the property of the Government, is to be altered to a new system.

Pacific Cable.—The new cable between Australia and New Zealand, which will be sanctioned by the Bill now going through Parliament, will cost about £175,000, which will be taken out of the reserve fund of the Pacific Cable Board, leaving £100,000 still in reserve. The cable will run between Sydney and Auckland, and the New Zealand headquarters of the Board will be removed to Auckland, in order to expedite the transmission of messages.

Spain.—The four largest of the eight stations under construction for the Spanish Compania Nacional de Telegrafia sin Hilos by Marconi's Wireless Telegraph Co. have been completed, and (with the exception of that at Teneriffe) were opened on Tuesday ; they are situated at Cadiz, Teneriffe, Las Palmas and Barcelona, and have a radius of 1,800 km. The smaller stations are situated near Madrid, Vigo, Soller, in the Balearic Islands, and at Alicante, and have a radius of 800 km.

La Compania de Telegrafia sin Hilos is the name of a new company which has been formed in Madrid, with a capital of £260,000, to acquire from the Oerlikon Co. the Spanish rights in the Marconi wireless telegraph system.

Sweden.—With reference to the application for a concession to build a wireless station in or near Stockholm, with the object of establishing a regular wireless connection with other countries, it is stated by *Affärsvärlden* that the existing contract between the Swedish Government and the Store Nordiske Telegrafselskab, of Copenhagen, gives that company the monopoly of cable connection with certain foreign lands, and even a preferential title to a concession for wireless telegraphy, which leaves very little chance for the new concession seekers.

Wireless Telegraphy.—A Reuter dispatch from Melbourne, dated November 28th, says that the Marconi Co. has notified the Commonwealth Government of its intention to take proceedings to test the right of other companies to use certain systems, including the Telefunken.

In a paper read by Herr Bredow, of the Telefunken Gesellschaft, at a meeting of the German Institution of Naval Architects, on November 23rd, the author stated that orders had been received this year for 390 stations for erection in 30 different countries. Communication between Germany and her colonies, in connection with which a distance of 3,720 miles had to be bridged over, was no longer impossible, as the station at Nauen had already covered a range of 3,100 miles. The official list of the Berne Telegraph Bureau showed that there were 713 stations on warships, 673 stations on merchant vessels and 197 land stations, a total of 1,583, of which 270 appertained to Germany.

The tower at Nauen, 100 m. in height, has recently been extended to a height of 200 m., making it second only to the Eiffel Tower in elevation. It had a range of 5,000 km. before the alteration, which will, of course, greatly increase its capabilities.

The Marconi station erected at Coltano, in Italy, is said to be the most powerful yet constructed. It is provided with plant of 1,000 KW., and has effected communication with Clifden in Ireland and Glace Bay in Canada without difficulty.

The need of a calling apparatus has been filled, it is said, by the Gesellschaft für Drahtlöse Telegraphie, of Berlin. A moving-coil galvanometer is provided with a sensitive indicator which, on the calling station giving a signal of 10 seconds' duration, makes a movement which is transmitted to a wheel connected with clockwork. This closes a circuit and actuates an audible signal.—*B.Z.a.M.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—NEW SOUTH WALES.—December 20th. One branching multiple magneto switchboard at Broken Hill, for the P.M.G.'s Department. See "Official Notices" September 22nd.

December 12th.—Ebonite earpieces, telephone cords, bronze and copper wire, Bleeck-Love cells and charges, and telephone material, for the P.M.G.'s Department. See "Official Notices" October 20th.

January 3rd, 1912.—Sixty-nine switchboards, magneto, non-multiple, for the P.M.G.'s Department. See "Official Notices" November 24th.

MELBOURNE.—December 19th. Deputy P.M.G. 2,750 rolled steel beams for use as telegraph and telephone poles (Sched. 579), 8,320 protectors and 16,640 fuses for main distributing frame (Sched. 619). Specifications, &c., High Commissioner in London, 72, Victoria Street, S.W., and at Board of Trade Commercial Intelligence Department.

SOUTH AUSTRALIA.—January 3rd. One wire-testing machine, for the P.M.G.'s Department. See "Official Notices" Nov. 24th.

N.S.W. GOVERNMENT RAILWAYS.—January 8th, 1912.—Four 1,000-KW. rotary converter units. January 22nd, 1912.—Supply and erection at the White Bay power house, Sydney, of eight water-tube boilers, with superheaters, economisers and mechanical stokers. January 29th, 1912.—A 25-KW. booster set. Particulars, Electrical Engineer's Office, 61, Hunter Street, Sydney.

Belgium.—December 19th. The municipal authorities of Saint Gilles-lez-Bruxelles are inviting tenders for a 1,000-H.P. steam engine with direct-coupled continuous-current generator, and a similar dynamo to be directly coupled to an existing engine.

December 27th.—La Société Nationale des Chemins de Fer Vicinaux, of Brussels, is inviting tenders for the contract for the overhead electrical equipment of the light electric railway line between Saint Vaast (Wazoir) and Bracquegnies.

Bosnia.—BJELINA.—December 20th. The T.C. invites offers for the complete installation of a public and private service, including station and staff dwellings. The pressure and system are left to the discretion of the tenderers. The street lighting is to consist of arc lamps for the principal thoroughfares, and metal-filament lamps in the secondary streets. The private lighting will require about 2,500 25-C.P. lamps, about half in use at the same time. Brown coal and water-power are available, and oil can be procured from Breka, 40 km. distant by rail. Plans, &c., will be forwarded, cost free, on application to the Stadtbauamt, Bjelina.

Brighton.—December 11th. One 750-H.P. three-phase induction motor, for the Corporation. See "Official Notices" to-day.

Cardiff.—December 7th. One hundred tons of British Standard No. 4 Section tramway rails, 46 ft. long, of British manufacture, for the T.C. J. L. Wheatley, Town Clerk.

Croydon.—December 22nd. The B.C. invites tenders for 2,000-volt and 5,000-volt switchboards, and erection of same complete (estimate £4,000). See "Official Notices" to-day.

Darlington.—December 4th. 500-KW. D.C. dynamo coupled to a reciprocating steam engine, for the Corporation. See "Official Notices" November 17th.

France.—January 5th, 1912. The French Post and Telegraph authorities in Paris are inviting tenders for a multiple telephone board for the Central Telephone Exchange.

Middleton.—December 12th. Feeder and distributor cable, for the Corporation. See "Official Notices" to-day.

New Zealand.—February 7th, 1912. Napier Corporation. (1) Permanent way, overhead work and supply mains; (2) power station, car-shed and repair-shop equipments; (3) rolling stock. Deposit 2½ per cent. Specifications can be seen at the Board of Trade Commercial Intelligence Branch in London.

Norway.—January 31st, 1912. The Norwegian military authorities in Christiania are inviting tenders for the supply of 100 sets of field telephone apparatus.

Siam.—December 30th. Tenders are invited for five electrically-driven centrifugal pumps for the waterworks at Bangkok. Particulars, Local Sanitary Department, Bangkok.

BANGKOK.—March 15th, 1912. Tenders are invited for the supply and erection of an electric power station with a capacity of 3,000 KW. Tenders, on the prescribed forms, to the Ministry of Local Government, Bangkok. For further particulars see this column last week.

South Africa.—JOHANNESBURG.—December 29th. Spare parts for tramcars and materials for overhead equipment, for the Municipal Council.

Spain.—The municipal authorities of Gelida (province of Barcelona) have just invited tenders for the concession for the electric lighting of the town during a period of 12 years.

Trimdon Grange (Co. Durham).—December 9th. Electric fittings for a year, for Walter Scott, Ltd., Trimdon Grange Colliery; the Storekeeper.

Uruguay.—February 6th, 1912. Tenders are invited by the Port Authorities at Monte Video for the supply of 13 electric cranes, together with 600 metres of steel rails. For further particulars, see this column for October 27th.

West Ham.—December 4th. Electric light installation at the Gainsborough Road Schools, for the Corporation. See "Official Notices" November 10th.

CLOSED.

Australia.—According to the *Australian Mining and Engineering Review*, tenders have been accepted as under by the Municipal Council of Sydney:—

Bare copper cable, £4,756.—British Insulated and Helsby Cables, Ltd.
Arc lamp contact and suspension gear, £293.—Lawrence & Hanson Electrical Co., Ltd.
Electrical accessories.—W. G. Watson & Co., Ltd., and India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
Motor-testing equipment.—Generators: Welsbach Light Co. of A., £244. Instruments: Noyes Bros., £524. Switchgear: Australian General Electric Co., £175.

Blackpool.—The Tramways Committee has accepted the tender of the United Electric Car Co. for six new "toast-rack" cars.

Bolton.—The B. of G. has accepted the tender of Messrs. W. Watson & Son, Ltd., for an X-ray installation, at £215.

Grimsby.—The Council has accepted the tender of Kabelfabrik und Draht Industrie Aktien-Gesellschaft for cables, at £1,017.

London.—L.C.C.—The Stores and Contracts Committee has recommended the following firms' tenders for acceptance for general stores required for 1912:—

ELECTRIC INSULATING MATERIALS.—G. Angus & Co., Ltd.; British Electrical and Manfg. Co.; B.I. and Helsby Cables, Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; D. Jaroslaw; Micanite and Insulators Co., Ltd.; J. N. Hardy & Son; G. Schultz & Co.; Siemens Bros. & Co., Ltd.; J. Thompson; Whiteley Bros.

LAMP GLASSES, SHADES, GLOBES, &c.—City Glass Co.; Falk, Stadelmann and Co.; General Electric Co., Ltd.; Johnsen & Jorgensen, Ltd.; Carl. Quitmann; Reform Lighting Co.

INDIA-RUBBER FOR MECHANICAL PURPOSES.—L. Andrew & Co.; J. E. Baxter and Co., Ltd.; I.-R., G.-P. and Telegraph Works Co., Ltd.; J. G. Ingram & Son; Irwell & Eastern Rubber Co., Ltd.; Leyland and Birmingham Rubber Co., Ltd.; G. MacLellan & Co.; Micanite and Insulators Co., Ltd.; New Liverpool Rubber Co., Ltd.; N. British Rubber Co., Ltd.; F. Reddaway & Co., Ltd.

HORNSEY.—The B.C. has accepted the tender of Messrs. Frith, Blakeley, Sons & Co., Ltd., at £638 10s., for the erection of coal-bunkers at the electricity works.

South Africa.—Our Durban correspondent sends the following information:—

BETHLEHEM (O.F.S.).—The electric light plant at Bethlehem is to be added to as follows:—

One 120-B.H.P. Premier gas engine, 80-KW. A.E.G. generator, storage battery of 260 cells, switchboard, &c.—A.E.G. Electrical Co., Johannesburg, £3,261.
One Dowson's bituminous gas producer plant, consisting of two retorts and vapourisers.—Haway & Co., Johannesburg, £943.
One travelling crane complete.—H. Davies & Co., Johannesburg, £130.

The present plant consists of Tangye's suction-gas producer and engines.

JOHANNESBURG.—The following contracts have been given to Henley's (S.A.) Telegraph Works Co., Ltd., of Johannesburg:—

5,500 ft. of ·05 sq. in., 3-core, paper-insulated, lead-covered and armoured cable, with conductors of their patent type for the Cinderella Cons. Mines.
2,000 pairs of 25 ampere 250-volt cut-outs, for Johannesburg Municipality.

Taunton.—The T.C. has accepted the tender of Messrs. Goodland & Son, of Taunton, for 2,500 tons of coal for the electricity works, at 15s. 5d. per ton.

West Ham.—The Electric Light and Tramways Committee has accepted the tender of the British Westinghouse Co. for the supply of converters required at the Bridge Terrace sub-station.

FORTHCOMING EVENTS.

Northampton Institute Engineering Society.—Friday, December 1st. At 5.45 p.m. At the Institute. Open debate on "The Prospects of the Technical v. the Practical Man."

Thursday, December 7th.—Smoking concert.

Friday, December 8th.—At 7.30 p.m. Annual prize distribution, by Sir Wm. H. White.

Association of Engineers-in-Charge.—Saturday, December 2nd. Social. Dance.

Society of Engineers (Inc.).—Monday, December 4th. At 7.30 p.m. At the Institution of Electrical Engineers. Paper on "The Design of Tall Chimneys," by Mr. H. Adams.

Institution of Civil Engineers.—Tuesday, December 5th. At 8 p.m. Further discussion on paper on "Electric Lighting of Railway Trains: The Brake-Vehicle Method," by Mr. R. T. Smith.

Wednesday, December 6th.—Students' visit to the Liverpool Street extension works of the Central London Railway.

Institution of Electrical Engineers (Yorkshire Section).—Wednesday, December 6th. At 7 p.m. Meeting at the University, Leeds.

Faraday Society.—Wednesday, December 6th. At 8 p.m. At the Institution of Electrical Engineers. Papers on "A Redetermination of the Density and Coefficient of Linear Expansion of Aluminium," by Mr. F. J. Brislee; "The Influence of the Physical Condition of Metals on Cathodic Overvoltage," by Messrs. J. N. Pring and J. R. Curzon; and other papers. Exhibitions of silica mercury lamps for spectroscopic and polarimetric work, by Dr. T. M. Lowry, and the Benko primary battery, by Mr. W. R. Cooper.

Institution of Electrical Engineers.—Thursday, December 7th. At 8 p.m. At the Institution of Electrical Engineers. Paper on "Notes on National and International Standards for Electrical Machinery," by Dr. R. Pohl.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—COL. H. M. LEAF.

The following orders are issued:—

Monday, December 4th.—"A" Company. Technical work and musketry instruction (standard tests), 8 to 10 p.m.
Tuesday, December 5th.—"B" Company. Lecture, 7 to 8 p.m; technical work and musketry instruction (standard tests), 8 to 10 p.m.
Wednesday, December 6th.—Gymnastic classes, 7 to 10 p.m.
Thursday, December 7th.—"C" Company. Lecture, 7 to 8 p.m.; musketry instruction (standard tests), 8 to 10 p.m.
Friday, December 8th.—"D" Company. Lecture, 7 to 8 p.m.; technical work and musketry instruction (standard tests), 8 to 10 p.m.
Saturday, December 9th.—Mobilisation week-end runs for "A" and "B" Companies at Dover, "D" Company at Coalhouse Fort, Gravesend. Trains leave for Dover (Victoria Station, L.C. and D. Ry.) at 1.39 p.m.; for Low Street (L.T. and S. Railway, Fenchurch Street Station) at 3.10 p.m. Dress for above runs: Service dress, putties, greatcoats, belts and haversacks.
URGENT.—All members of the corps are requested to attend headquarters on their company night to sign Association Form 20, recently received from the County of London Association.

(Signed) P. H. CAMPBELL, Capt. R.E. and Adjt.,
For Officer commanding L.E.E.

To Boost Electricity in Spain.—According to *Industria e Invenciones* it is the intention to call together a congress of Spanish electricians, with a view to considering the means for stimulating the development of electricity and its various applications throughout Spain.

Mining Prosecution Fails.—Among the charges brought against a Dumbartonshire mine manager, and found not proven, was one of having an electric safety lamp relighting apparatus in use which was not securely locked so as not to be available for use except by a person duly authorised. The prosecution was the sequel to a fatal explosion.

Fatalities.—Mr. W. G. Grant, electrician at Messrs. Gray's carpet works, Ayr, has died in the County Hospital as the result of burning injuries received through falling into a tank of boiling dye.

Robert Hobbs, a Glasgow electrician, was found dead last Saturday at the bottom of the hold of a new steamer. He was employed by Messrs. Watson & Co., Ltd., electricians, of Glasgow.

BULK SUPPLY AT TURTON, LANCS.

Turton is situated some three miles from Bolton, and is a favoured residential district. The Council applied for and obtained its provisional order in 1909; nothing was done, however, until 1910, when the Council sought the services of Mr. R. B. Leach, with a view to turning its powers to account, and appointed him as its electrical engineer.

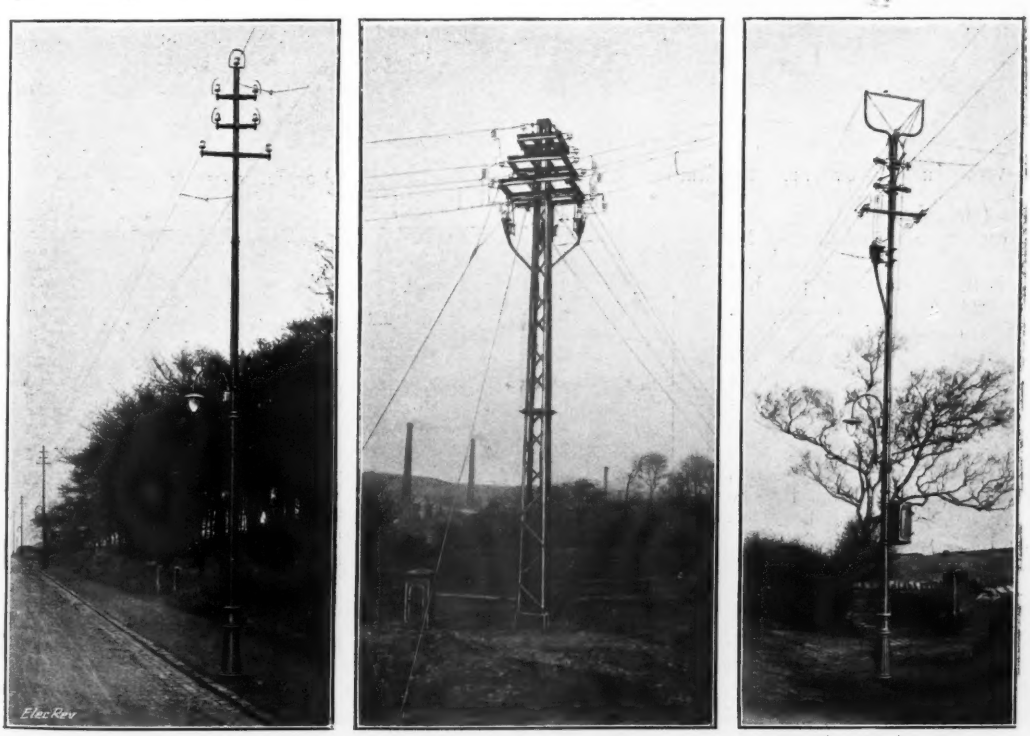
Mr. Leach drew up a scheme which, when completed, will consist of some 8 miles of mains and 150 street lamps. The system includes a duplicate supply from an outside source through a ring main, but, owing to the distance from the source of supply, it has been necessary to allow for step-up transformers. This has a twofold advantage: (*a*) copper sizes are reduced to a minimum; (*b*) as the copper lines, where run overhead, can be kept small, it follows that light steel poles can be used, and this alone adds considerably to the appearance of the work.

One point which augurs well for the permanent service of the scheme is that the Council, after fully discussing the matter with its engineer, came to the conclusion that it would not pay to build a station entailing high capital charges, with either heavy fuel-transport costs or water difficulties, especially as the Lancashire Power Co. had a sub-station in the area and was able to offer a supply to the Council upon very favourable terms. It must be quite obvious even to the lay mind that a large works turning out many millions of units can, by low works cost and centralisation, generate very much cheaper than a small station where supervision and management must be out of proportion to the units generated, and that fact the Turton Council readily grasped.

The first portion of the scheme was formally opened on November 2nd.

Three-phase, four-wire, 50-period current is delivered from the Lancashire Power Co.'s bus-bars at 230 volts between phase and neutral wire to a Prescot switchboard, on which are mounted two Aron three-phase 100-ampere meters, fitted with a Merz time element, three edgewise type ammeters, and one edgewise type voltmeter fitted on a movable arm bracket, three main 100-ampere fuses and two Prescot cable units, one of which is spare. From the sub-station a three-phase four-wire circuit is run on wooden poles (each wire being ·05 sq. in. section) to a lattice steel distribution pole,

Sub-station, Turton Electric Supply.

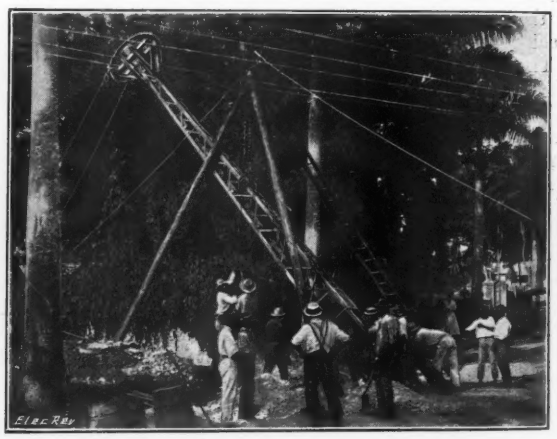


Examples of Pole-Line Work, Turton Electric Supply

a distance of ¼ mile. Here is fixed a three-way feeder pillar which controls on the west a circuit some 350 yards long to

Laying Cable, Bridgetown, Barbados.

Chapeltown Road district, and, on the east, the circuit to Bradshaw Road district. The mains from the feeder pillar to a position about the middle of Bradshaw Road are run on



Views showing Overhead Distribution, &c., Bridgetown (Barbados) Electricity Supply (see p. 909).

wood poles (two phases only and two neutrals), each wire being ·025 sq. in. section, the length being 570 yards. At this point is fixed a cast-iron pole box containing two Venner time-switches, which switch on the 65 lamps along Bradshaw Road. The switches are arranged to operate twice during the 24 hours during winter, so that the work-people may have light on their way to the mills in the morning. In the evening the light is switched on from dusk until 11.15 p.m. From here to the southern terminus of the line, situated some 1,500 yards away, the poles are arranged to take an additional four wires, which will supply the Bradshaw area; also, to a point some 2,300 yards northwards along the Bradshaw Road, one phase wire and two neutrals are run. The neutral wire is in duplicate throughout, and being placed below the line-wires and cross-laced, forms an effective guard cradle.

The steel poles are 29 ft. long for three-wire circuits, and 31 ft. long for seven wires, made up in three sections—5 in., 4 in. and 3 in. dia. respectively. All cross-arms carrying insulators are of iron, those on the line poles being of flat section and those on terminals of channel.

The actual lighting is effected by means of a 50-c.p. metal-filament lamp fixed in a neat bracket attached to each steel pole, and spaced approximately 200 ft. apart and 12 ft. from the ground-level. At night the effect is all that can be desired, a dull country road being transformed into a well lit county thoroughfare.

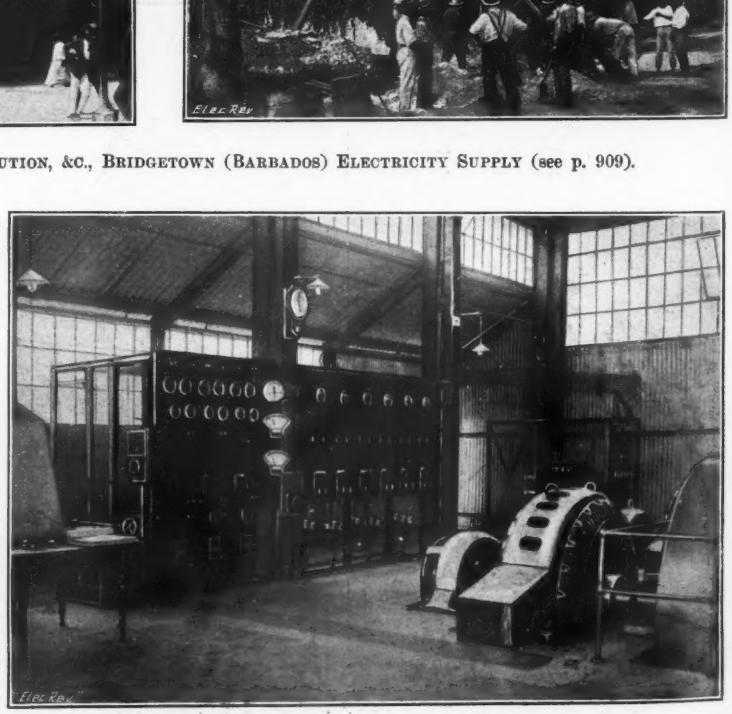
To have lighted this road by gas would have necessitated laying a 5-in. main, which in itself would have been an expensive item, while the price of 3s. 1d. per 1,000 cb. ft., which the Bolton Corporation would have charged for gas, would also have been a heavy expense.

Supply is being given to several large houses on the route, and the Council will be busy for some time adding connections to the system; persons who have private plants are finding it advantageous to discard them and take a supply from the Council's mains.

A show room is shortly being opened, which, with the wiring department which it is intended to start, will soon be in full swing.

In conclusion, we believe there are numerous small townships similar to Turton (situated in the area of one or other of the large supply companies) which, by taking bulk supply, would find an easy solution to their lighting problems, especially when it is considered that the cost to many small districts for street lighting alone runs into some hundreds of pounds per annum.

We are indebted for the above particulars to the Council's chief electrical engineer, Mr. R. B. Leach, and to Mr. Lang, of the British Insulated and Helsby Cables, Ltd., which company carried out the whole of the work.



Interior of Power Station, Bridgetown, Barbados.

ELECTRICITY SUPPLY IN BRIDGETOWN, BARBADOS.

Ever since 1899, when the Barbados Legislature passed the Electric Light and Power Act, 1899, efforts have been made

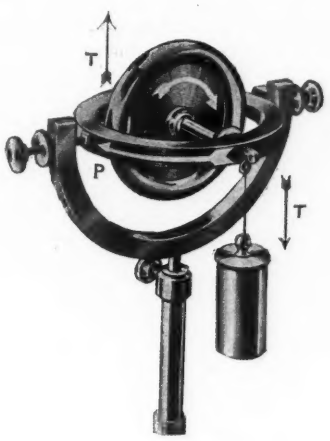


Fig. 1.—Experimental Gyrostat (see p. 910).

to provide the oldest of our West Indian Colonies with a supply of electricity for lighting and power purposes.

That such an undertaking would be a profitable business, could easily be assumed from the ideal conditions existing, and which are more or less present in all tropical towns.

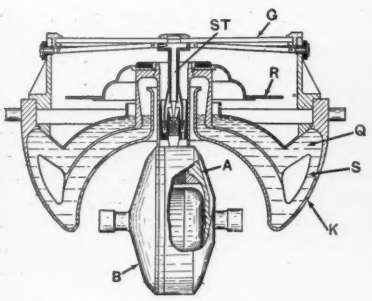


Fig. 2.—Section of Gyro Compass.

Among these might be cited the price of gas—11s. per 1,000 cb. ft.—charged by the existing gas company; the ease and small outlay with which outlying suburbs and sugar estates can be reached by overhead lines as compared with gas pipes, seeing that the soil consists of corral rock; and, finally, the low cost at which electricity could be generated by Diesel engines, having regard to the oil developments in the neighbouring island of Trinidad.

Notwithstanding these obvious advantages, efforts to promote a company for the purpose of supplying electricity failed until July, 1909, when, through the efforts of Messrs. Hooghwinkel, Anthony Brown & Partners, a company was registered under the title of the Barbados Electric Supply Corporation, Ltd.

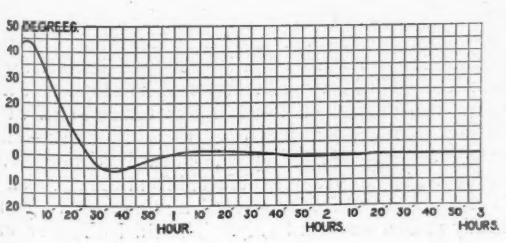


Fig. 4.—Compass Settling on the Meridian.

The required plant was ordered, and the erection pushed forward in the face of many difficulties, so as to be ready for a supply on Coronation Day, which was fortunately achieved.

The generating station building consists of a steel frame with corrugated iron sides and double corrugated iron roof, and is situated on the main road which skirts the sea, on land formerly belonging to the Royal Mail Steam Packet Co.

The plant consists of two 200-h.p. Mirrlees-Diesel oil engines, running at 250 r.p.m., and direct coupled to two G.E.C. three-phase alternators, each capable of an output of 135 kw. at 3,300 volts, 50 cycles, at unity power factor.

The open protected type direct-coupled exciters are mounted on brackets fixed to the outboard bearings, and foundations for a third set have been provided.

A cooling tower to supply the necessary cooling water, fuel tanks, pumps, pipes, &c., complete the installation.

A 250-ton oil tank with two hand pumps has been erected near the pier, where the oil can be pumped from the tank barges. This will enable the company to store a six months' supply, an absolute necessity at present when oil is used in a public supply of electricity. The consumption of fuel has been guaranteed at 0·47 lb. per b.h.p. at full load, or 0·57 lb. per b.h.p. at half-load, but probably a lower figure will be obtained.

The main switchboard, in addition to the generator panels, contains six feeder panels and a single-phase lighting panel.

The distribution system consists of a 3,300-volt underground feeder system, and overhead distributors on wooden poles at 120 volts with a four-wire star connection giving about 210 volts for power supply between the outers; most of the distributors are 0·1 sq. in. bare hard-drawn copper wire.

The feeders are nearly all of 0·1 sq. in. three-core paper-

Fig. 3.—Component Parts of Compass.

insulated lead-covered double-tape armoured cable with a preservative tarred serving overall, laid direct in the ground;

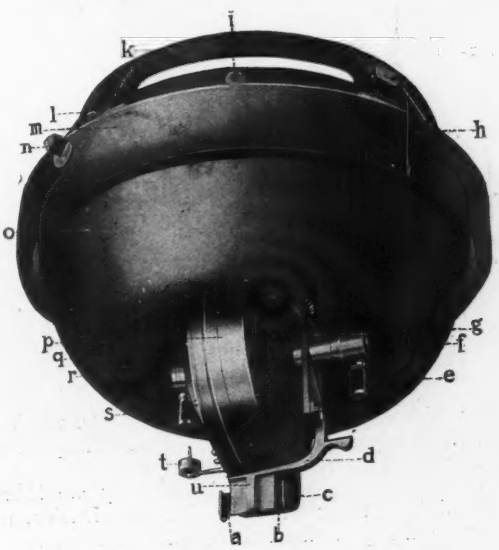


Fig. 5.—View showing Damping Device

the feeders are about 13,000 yards, and the distributors about 65,000 yards, in length.

There are six transformer sub-stations of 150-50 KW., one in the power station, and the largest housed in a small brick building. The others are housed in specially-constructed ventilated corrugated-iron transformer houses with hinged doors to provide for the inspection of the switch-gear and voltmeters.

The transformers are of the oil-cooled Berry type.

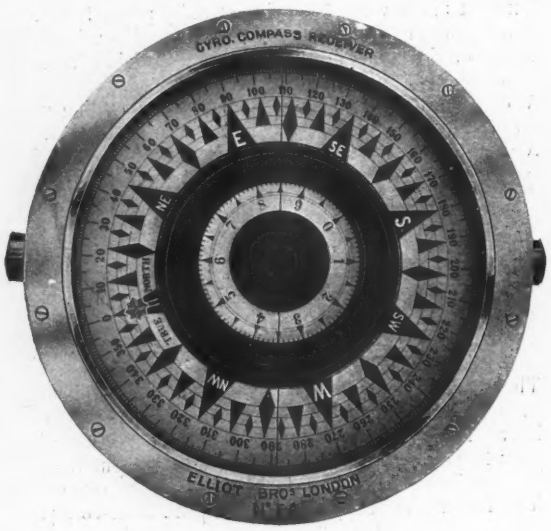


FIG. 6.—RECEIVER DIAL.

Six special lattice poles with angle-iron distributor rings on the top act as feeder points to the overhead system, the leads rising inside the poles.

The lines are well protected with lightning arresters, and where necessary guard wires have been erected to protect the existing telephone wires.

Most of the installation work is being carried out by the company with exposed wiring carried on cleats, which is, of course, the only proper system in a tropical damp climate with many wooden houses, besides being cheap.

The consulting engineers to the company are Messrs. Hooghwinkel, Anthony Brown & Partners, London, and they have been responsible for the design and the construction of the works.

FIG. 8.—RECEIVER ON PEDESTAL.

FIG. 9.—ORDINARY GYRO COMPASS.

THE GYRO COMPASS.

OF all the interesting instruments shown at the recent Electrical Exhibition, none could possibly excel in interest and mechanical perfection the Anschütz "Gyro compass" exhibited by Messrs. Elliott Brothers.

This instrument affords another admirable example of pure physics applied to industrial purposes, for it was the famous French physicist, Foucault, who first investigated the laws controlling gyrostatic phenomena, and laid down the fundamental proposition upon which the working of the Anschütz compass depends, namely, that a gyrostat with freedom to move in two planes only would at any place on the earth's surface (other than the poles), tend to set itself with its axis of rotation parallel to the axis of the earth, by reason of the relative rotations of the two bodies.

FIG. 7.—GYRO COMPASS (MASTER).

Although the experiments on which this law was based were carried out nearly 60 years ago, no serious attempt was made during the last century to utilise the gyrostat for the purpose of a compass. The increasing use of steel, however, in the construction of ships, and especially the use of immense moving masses of steel for the guns of modern battleships, rendered it more and more difficult to compensate the magnetic compass so as to eliminate the effects of such disturbing factors, and gave that stimulus to the demand for an efficient substitute which has led to the development of the gyro compass.

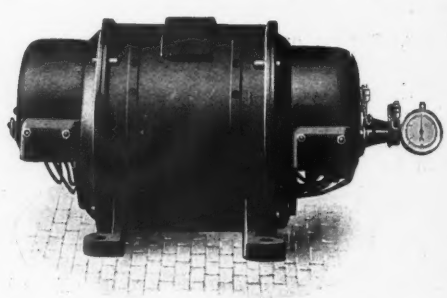


FIG. 10.—MOTOR-ALTERNATOR.

The earlier attempts were directed to the construction of a gyro with three degrees of freedom, which would preserve a direction fixed in space; but it was found impossible to overcome the difficulties which arose. The adoption of the gyro with two degrees of freedom was found to afford a satisfactory solution, but for one serious drawback—that owing to the great mass, high speed, and small friction of the moving parts, if the gyro were deflected from the meridian it would oscillate to and fro for a very long time, so that it was practically useless on board ship. This final difficulty was removed by the adoption of a most ingenious damping device, which has proved perfectly effective in steadying the compass.

and enabling it to be developed to a degree of efficiency never attained by the magnetic compass.

The result is that the gyro compass has been adopted by all the leading navies and by many merchant vessels, and is certain to be more and more widely used as its merits become better known. It also affords a solution to the problem of equipping submarine boats with compasses independent of terrestrial magnetism.

The gyro compass, however, is not independent of electromagnetism; it is, indeed, only by the aid of this agency that its operation is rendered practically possible, for no other known means could maintain its fly-wheel in rapid rotation for an indefinite period, and it is for this reason that we give below a description of the apparatus. The gyro, in fact, is an electrical device, embodying within its innermost recess a squirrel-cage three-phase motor, and transmitting its indications to any desired point by electrical means.

The limitations of our space prevent us from explaining in detail the dynamical principles upon which the compass depends, and a brief statement must suffice. It is well known that if a gyrostat mounted as shown in fig. 1 (p. 909), with its wheel revolving rapidly in the direction of the arrow, is subjected to a turning couple, indicated by the arrows T T, the frame carrying the wheel will tend to rotate in the direction of the arrow P—in a plane *at right angles* to that containing the couple T T. The direction of the rotation P is always that which tends to bring the plane in which the wheel revolves into that containing the couple T T, and so that the wheel rotates in the same direction as the couple T T. When (if ever) that condition is reached, the frame has no further tendency to rotate. The rotation of the frame is termed "precession," and always takes place by the shortest path to the position of stability.

In the gyro compass the case containing the revolving wheel is carried by a float in a bowl of mercury. The surface of the mercury is maintained by gravitation always in a plane tangential to the earth's surface, and assuming for simplicity that the compass is situated at the equator, with its axis pointing east and west, it will be seen that the rotation of the earth from west to east is always tilting the plane of the liquid surface with regard to the gyrostat, and in effect applying a couple exactly analogous to that indicated by T T in fig. 1. Hence the floating gyrostat rotates, trying to place its axis north and south, in which position the wheel would revolve in the same plane and in the same direction as the earth at the equator. The directive force acting upon the gyrostat diminishes as this position is approached, passes through zero as it is attained, reverses as the inertia of the system carries it beyond the meridian, and finally brings the gyrostat to rest in a position practically opposite to that in which it started. Precession then recommences in the opposite sense, and the frictional damping being comparatively negligible, the oscillations thus set up might continue indefinitely, were it not for the damping device described below. The effect of the latter is always to oppose precession to a degree proportional to the tilt of the gyrostat, and thus, while an undamped gyrostat would oscillate for an indefinite period, the actual instrument attains a steady position on the meridian in a few hours from the starting-up of the motor.

A little consideration will show that at any other latitude than the equator, the directive force due to the earth's rotation will be less than at the equator, in proportion to the cosine of the latitude, becoming, therefore, zero at the poles—just as the magnetic compass loses direction at the magnetic poles. The directive force acting on the gyrostat, however, is estimated at 15 times as much as in the case of a magnetic compass, and is always ample for practical purposes, even at the highest latitudes usually attained. A number of small corrections are necessary: for change in latitude, for the direction of the ship, and for changes in the speed of the ship; in practice, the last two can be combined, and all of them are readily ascertainable from tables. Variations in the pressure of the electricity supply exert no appreciable influence upon the gyro.

Having thus briefly indicated the nature and performance of the gyro compass, we may now proceed to describe its mechanical details. Fig. 2 is a vertical section through the centre of the compass; A is the gyro wheel, housed in a casing B, which is carried by a tubular stalk from the float S; the latter is supported by mercury Q in the bowl K, and carries also the compass card R, the N-S line being directly over the axle of the gyro. The instrument has a glass cover G, which supports a steel stem S T at the centre, for the purpose of keeping the floating system central; the stem also dips into a mercury cup on the gyro, and is connected with a terminal at the periphery of the cover, whilst a steel tube concentric with the stem makes contact with an annular mercury cup, as shown, and is connected to a second terminal. These two connections are insulated from one another and the metal of the apparatus, and carry two phases of the motor supply; the third is conveyed by way of the mercury bath, float, &c., the whole instrument being insulated from the binnacle. The mercury bowl is suspended on gymbals in the usual way, the outer ring being borne on springs to protect the apparatus from shock.

The fly-wheel of the gyro, which is fashioned with its shaft out of one piece of special nickel steel, contains the rotor of the three-phase induction motor, with short-circuited copper bar winding, while the stator is mounted inside the case B. The motor has two magnetic poles, and drives the wheel at 20,000 R.P.M. The spindle runs on ball bearings of specially hard steel, and is flexible, so that, above the critical speed, the gyro wheel is free to revolve about its centre of gravity. Owing to the arduous conditions imposed by the very high speed and considerable mass of the gyro wheel, every part has to be constructed of the finest materials and the best possible workmanship.

Fig. 3 shows the component parts of the complete instrument, namely, the mercury bowl and gymbal rings, the gyro wheel, the floating system with compass-card attached, and the top cover.

The damping device is shown in fig. 5. It consists of a small shutter *u* attached to a pendulum arm *d*, which is carried on pivots, and swings to the right or left when the axis of the gyro is tilted. Air is admitted to the gyro case by the inlets *g*, and is expelled by the rotation of the wheel through the channel *c* in two streams, through *a* and *b*. When the gyro is tilted, the shutter partly closes one outlet and opens the other more widely, so that the issuing streams of air are no longer equal, and the resultant effect is a torque tending to rotate the gyro round a vertical axis in such a sense as to bring the axis of the gyro horizontal, as above explained. The powerful damping effect produced is well shown by the curve, fig. 4, from which it will be seen that, even if the axle is 45° from the meridian when the motor is started, the compass settles down to within 1° of the meridian in less than two hours. In the case of the master compass, a still simpler damping device is employed, working on a similar principle.

A peculiarity of the gyro compass—that while the card can oscillate about a north-south axis, it cannot oscillate about an east-west axis—has the valuable result that a point on the east or west of the card can only move straight up and down, not in a circular path, and this renders it easy to apply a system of transmission mechanism that would be impossible with a magnetic compass. When this is done, the master compass containing the gyro, and fitted with a transmitter, can be situated anywhere low down in the ship where it is best protected from injury—in positions where a magnetic compass would be rendered useless by its being surrounded with masses of steel—and any number of receivers can be fixed wherever desired, accurately reproducing the indications of the master compass. The latter is provided with a revolving case or binnacle, driven by a reversible motor, which is controlled by contacts actuated by the gyro. Fig. 7 is a view of such an instrument. Whenever, through the movement of the ship, a contact attached to the binnacle touches a contact on the compass card, the motor begins to rotate in that direction which tends to separate the contacts, which being done, the movement ceases. A commutator on the spindle of the motor sends currents to all the receivers, which are provided with mechanism which causes the receiver cards to rotate in exact agreement with the transmitter. Fig. 6 shows the dial of a receiver, which it will be noted is provided with a central card reading to 10°, in addition to the outer card. The small card is geared to the larger one so as to make a complete revolution while the latter rotates through 10°, and provides, therefore, a reading about 15 times as sensitive

as that of the large card—allowing for their relative diameters. The importance of this will be obvious when it is considered that it enables a much straighter course to be steered, effecting a very material economy of time and fuel on a long voyage. Fig. 8 shows the receiver mounted on a pillar.

A small motor-generator, supplied from the ship's mains, is used to generate three-phase current at 120 volts, 333 cycles per second, for the gyro-motor. The machine, which is shown in fig. 10, runs at 2,500 R.P.M., and the three-phase part of it has 16 poles. The D.C. and A.C. circuits are entirely insulated from one another. The power taken by the machine is about 700 watts. It is controlled by a suitable switchboard, fitted with meters, duplex fuses, &c.

Fig. 9 shows a complete gyro compass with the top cover removed; *a* is a spirit level, *b* the central stem, and *c* a clamp screw for adjusting the "lubber point," to make the latitude correction already referred to.

We are indebted to Messrs. Elliott Bros. for the particulars upon which the foregoing article is based.

NOTES.

Electrical Engineers' Ball, 1912.—The ninth annual ball is to be held at the Hotel Cecil on Friday, February 16th. A strong committee has been formed, the first list of its members being as follows:—

Committee:

Alabaster, H.	Gavey, Sir J.	Nash, E. A.
Andrews, Leonard	Gray, Jas.	O'Meara, Major
Bailey, Frank	Gray, R. Kaye	Pearson, Hugh A.
Baldwin, O. H.	Hadley, A. E.	Petersen, T.
Belfield, R.	Hammond, R.	Railing, M. J.
Blunt, W. W.	Hill, Charles	Raworth, J. E.
Bowden, J. H.	Highfield, J. S.	Roberts, Martin F.
Browett, T.	Hirst, H.	Rutherford, W.
Brown, C. S. Vesey	Holden, Col. H. Capel	Rowell, G. F.
Byng, E. G.	Hooper, J.	Sharp, Sydney
Callender, Jas.	Kingsbury, J. E.	Shepherd, J.
Cramb, A. C.	Lacey, E. M.	Siemens, Alex.
Davenport, F. R.	Lane, W. E.	Sillar, A. M.
Dickinson, Harold	Leaf, H. M.	Scholey, H.
Dobson, Sydney	Leigh, F. A. C.	Spagnoletti, J. E.
Erskine, R. S.	Madgen, W. L.	Sparks, C. P.
Ferranti, S. Z. de	Mathews, W. Lee	Steinitz, J. J.
Fox, E. J.	Mordey, W. M.	Sutton, G.
Garcke, E.	McMahon, P. V.	Taylor, J.
Gatehouse, T. E.	Murray, Lee	Wallis-Jones, R. J.
	Nalder, F. H.	Wordingham, C. H.

Executive Committee.—Baldwin, O. H.; Fox, E. J.; McMahon, P. V.; Wallis-Jones, R. J.

Hon. Secretaries.—Alabaster, H.; Sillar, A. M.

Hon. Treasurer.—Kingsbury, J. E.

Educational Notes.—A course of eight lectures on "Illumination and Photometry," will be delivered at University College, Gower Street, W.C., by Mr. W. C. Clinton, on Wednesdays at 6.30, beginning on January 10th, 1912. The fee for the course is two guineas; by the courtesy of the Provost, we are authorised to nominate three persons for admission to the course at a special fee of one guinea each, and we propose to nominate those three applicants who give the best reasons for our doing so, before December 17th.

The eighteenth annual dinner of King's College Engineering Society was held at the Hotel Cecil on Friday last. Dr. W. C. Unwin, F.R.S., President of the Institution of Civil Engineers, occupied the chair. Dr. Headlam, in responding for "The College and Staff," said there was great need at the present time that the three great engineering colleges of London should work together to introduce a more rational, more professional, and more practical system of examinations in engineering.

On Friday last, the new Mechanical Engineering Laboratory of the Belfast Municipal Technical Institute was formally opened by Prof. J. Perry, F.R.S., who delivered a heavy indictment of the methods of so-called teaching in vogue in the public schools and Universities, and advocated training in natural science.

Appointments Vacant.—Assistant engineer for the Liverpool Corporation (£200); senior operator at Bristol for the Provincial Cinematograph Theatres, Ltd. (50s.); assistant civil and electrical engineer for the Public Works Department, Trinidad (£309—£350); foreman for the Newport Tramways repair department. See our advertisement pages to-day.

"The Adventures of Eddie Currant."—In the Co-operative Hall, at Rugby, on Thursday, December 7th, and two following nights, "The Donuts" will give performances of the burlesque, "The Adventures of Eddie Currant." Who are the "Donuts?" and what is this burlesque? The former are the staff members of the British Thomson-Houston Co., Ltd., who, in their spare time, become members of the "Donuts" Association. The latter is a play written and produced by electrical men for electrical men. It is a technical burlesque; the scenery and stage effects are described as truly remarkable, and the performances take place on "three nights only." We have no doubt that the many friends of the B.T.-H. staff will be interested to learn of the arrangements, and if any of them happen to be within easy reach of Rugby on any of the nights named, at 7.30 o'clock for 8 o'clock, they may be sure of a good reception and that their presence will be greatly appreciated. The tickets are 1s. and 6d., with reserved seats at 2s. 6d. and 1s. 6d., and the honorary "Donuts" secretary is Mr. T. H. Relton, of 159 Clifton Road, Rugby.

Parliamentary. — *Electric Lighting Undertakings (Auditors).*—Mr. Grant, on Monday, asked the President of the Board of Trade if he would state whose duty it was to fix the remuneration of Government auditors for annual reports upon electric light undertakings liable to be taken over by municipalities, and why it is that the amount charged by such Government auditors is, in cases, in excess of ordinary prices.—Mr. Buxton replied that the duty of fixing the remuneration of these auditors, who are in all cases chartered or incorporated accountants, rests with the Board of Trade. He was not aware that the amount fixed was in any case unreasonably high, but if the hon. member would inform him of any such case, he would be pleased to inquire into it.

Peel-Conner Telephone Works, Ltd.—Mr. O'Grady asked the Postmaster-General whether he was aware that the Peel-Conner Telephone Works, Ltd., Manchester, had during the time they were carrying out a Government contract reduced the piecework prices of girls on certain portions of the contract from 10s. 6d. to 7s. 6d.; whether he was aware that a strike ensued in consequence, and if so, could he state whether the firm, having tendered for a Government contract on a definite price, was entitled thereafter to the advantage arising from their action in reducing wages. The Postmaster-General said he was aware that the company had made certain alterations in their piecework prices, with the consequence that some of their staff of girls had struck work. There was no recognised district rate for the work on which the girls were engaged, and he was concerned with the piecework prices fixed by the company only so far as those prices would affect the actual earnings of the workers. The matter had been specially investigated by his inspecting officer, and in view of his report, he was not satisfied that the new prices would result in a reduction of wages, or that they were inconsistent with the Fair Wages Clause. The girls who struck work did so before the new rates could be given a trial, and he was informed by the employers that some who remained at work were earning higher wages than under the old rate. If the hon. member gave him further information he would have further inquiry made.

Continuously-Loaded Telephone Cable.—The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., of Silvertown, Essex, have recently made and delivered to the Italian Government a shipment of bi-core continuously-loaded telephone cable, of a total length of 30,000 metres. The cable consists of two gutta-percha insulated cores, the conductor of each being a strand of seven 0·7 mm. copper wires, covered with a layer of fine soft annealed iron wire 0·2 mm. diameter, and then insulated with three layers of pure gutta-percha to a diameter of 6·5 mm., the two cores being then laid up together, wormed and served with specially-prepared jute yarn, taped and covered with a special alloy tube. As the company possess large hydraulic presses, it was possible to make this cable in lengths of 300 metres without joint and without any stoppage for refilling the container. The results of electrical tests on the cable showed:—

Electrostatic capacity under steady current 0·0894 mfd. (between wires) per km.

Conductor resistance under steady current 11·745 int. ohms (loop) per km. at 15° C.

Conductor resistance with alternating current 1,000 p.p.s., 12·546 int. ohms per km. at 15° C.

Inductance with alternating current 1,000 p.p.s., 5,872 millihenries (loop) per km. at 15° C.

Attenuation Constant.—The attenuation constant of the iron-whipped cable per kilometre loop at 1,000 p.p.s. is 0·024.

It may be observed that without the iron whipping a cable of this type would have had an attenuation constant of 0·057 per kilometre loop. In other words, the attenuation constant is reduced by 58 per cent., owing to the iron whipping. The latter, therefore, more than doubles the speaking range of the telephone cable.

Copper.—The position of the copper market is discussed in an article in the *Financier* for November 24th, touching upon the increase in price both of the metal and securities pertaining to it; the writer considers that this is due, in the States, to persistent curtailment of production, though in Europe it may be an indication of reviving trade. According to the statistics for American production, last month's (October) was 59,127 tons, against 63,234 tons in October, 1910. At the same time, deliveries for home consumption and for export have fallen from 68,000 to 62,076 tons. Consumption has thus fallen off to a still greater extent than production. The European situation is more favourable. Supplies have advanced from 431,313 tons for the 12 months ending October 31st, 1909, to 440,970 tons in the 12 months ending October 31st, 1910, and 459,865 tons in the 12 months to October 31st last. Consumption has also risen, from 451,905 tons in 1909-10 to 486,451 tons in the year to the end of last month. The price of the metal is only 27s. higher per ton than at the same date last year. The increase in European supplies, coupled with decrease in those from United States, implies an increased production over here.

The Light of the Firefly.—Experiments recorded in *Nature*, of November 23rd, indicate that the light emitted by fireflies possesses some of the properties of the X-rays and ultraviolet light, producing strong effects upon photographic plates through media opaque to light, but not through glass.

The M.E.A. Bill.—On Tuesday, Sir Howell Davies introduced a Bill (on behalf of the I.M.E.A.) in the House of Commons, to amend the Acts relating to electric lighting, the primary object of which is to obtain powers on behalf of municipal electricity suppliers to provide, sell, let for hire, and fix, repair, maintain and remove (but not manufacture for these purposes) lamps, meters, electric lines, fuses, switches, fittings, lampholders, motors and other fittings, and provide all materials and work necessary to that end. Another important clause relates to the borrowing of working capital in connection with electricity undertakings; we note also that one clause seeks to legalise delegates' expenses to such gatherings as the M.E.A. conferences. There are 10 clauses in all.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. E. S. TAYLOR has been appointed deputy engineer and manager to the Hankow Light and Power Co., Ltd., Hankow, China, and he has therefore resigned his appointment as chief assistant to the Hendon Electric Supply Co., Ltd. He sails for China at the end of December.

The salary of MR. SEDDON, electrical superintendent at the West Ham generating station, is to be increased to £250 as from April 1st last.

The salary of MR. J. C. GILL, borough engineer at Peterborough, as electrical engineer, has been increased from £100 to £150; Mr. Gill also receives £300 as waterworks engineer, and other emoluments. The electrical undertaking showed last year a profit, after paying financial charges of £500, and it already shows £200 more than that sum this year.

General.—Our Indian correspondent says it is reported that MR. J. S. PITKEATHLY, the Electrical Inspector to the United Provinces, India, has resigned his post, and will leave the country after the Durbar in February, 1912. His successor will be appointed through the Secretary of State. MR. JANSEN, who was Assistant Electrical Inspector under Mr. Pitkeathly, has also resigned his post, and has returned to England. In spite of the "Official Secrets Act," rumour has crept about that these two resignations are not entirely disconnected with the fact that certain Royal Engineers, drawing very much higher salaries than the engineers who have resigned, were appointed assistants on the Delhi Durbar works. The Government is losing a good sound engineer, and an energetic one in Mr. Pitkeathly, and will find it hard to get such a useful man. Our correspondent also writes that MR. J. W. SHORTH, who has for about 14 years been chief engineer to Messrs. Balmer, Lawrie & Co., of Calcutta, has just resigned his post and left the country for good. It is whispered that he has made a handsome fortune in a comparatively short space of time. He departs with the best wishes of his friends, who have known him to be a keen business man, a fair dealer and a good fellow generally. His place has been filled by MR. W. HODGSKINSON of the same firm.

Indian Engineering says that MR. A. E. MCCLOSKEY, expert in telegraph, telephone and railway signalling systems, "who comes from the engineering department of the British Post Office and has been on loan to the Bombay, Baroda and Central India Railway during the past 18 months, has now handed in his report on the reorganisation of the company's telegraphs." It is understood that he has been successful in obtaining for the company several concessions from the Government.

The appointments of external examiners for the session 1911-12 of the Liverpool University contains the following:—Faculty of Engineering—Electrical Engineering, S. P. THOMPSON, D.Sc., F.R.S., Principal and Professor of Physics, City and Guilds Technical College, Finsbury, E.C.

DR. GLAZEBROOK, director of the National Physical Laboratory, has been suffering from a very serious attack of enteric fever, but is now, we are glad to say, on the road to recovery.

MR. ALBERT W. MARR, of Aberdeen, has been appointed chief electrical engineer to the Raneegunge Mining Association at their Bengal coalfields. He sailed on Saturday last to take up his duties.

MR. E. V. JOHNSON, late technical representative for Messrs. Willans & Robinson, Ltd., in South Wales, has joined the firm of Messrs. W. V. Waite & Co., Ltd., Cardiff.

The Edison and Swan United Electric Light Co., Ltd., are shortly sending MR. PAKENHAM W. BEATTY out to Buenos Ayres as their South American representative and manager, with the object of establishing in that city their headquarters for South America, and their first branch in the country. We are informed that in view of their rapidly increasing trade in South America, the Edison & Swan Co., feel it imperative that a representative of the company should reside there, and that a stock of electrical goods should be available in the great South American commercial centres. In time the company intend to establish branches in all the large towns in the South American Republics, Buenos Ayres having been chosen as a site for their first branch on account of the many obvious commercial advantages it possesses to-day. Mr. Beatty has already had several years' experience in South America, having acted as resident electrical engineer to the South American Light and Power Co., of Bahia Blanca, an undertaking in which the Buenos Ayres and Pacific Railway Co. are the largest shareholders. In that city Mr. Beatty recently superintended, under the direction of Mr. J. F. C. Snell, of Messrs. Preece, Cardew & Snell, the complete remodelling of the lighting company's plant, the erecting of a large generating station for the Buenos Ayres and Pacific Railway Co., and the electrification of the Bahia Blanca Tramway's Co.'s system. During his stay Mr. Beatty was also responsible, under the same direction, for the design and carrying out of several large lighting and motor installations for the railway company at their docks, workshops and sheds. The preparation of the Edison & Swan Co.'s new South American catalogue in Spanish and Portuguese is now in hand, and will shortly be ready for publication.

Obituary.—CARYL DAVID HASKINS.—We regret to record the death of Mr. C. D. Haskins, an electrical engineer of great eminence in the U.S.A., and manager of the lighting department of the General Electric Co., of Schenectady, which occurred suddenly from pneumonia at Salt Lake City on November 18th. Mr. Haskins, who was only 44 years of age, was born in America, but received his education in England. In 1888 he entered the employ of S. Z. de Ferranti & Co., as a junior assistant engineer, and was placed in charge of the manufacture of electric meters, assisting also in preparing the plans and specifications of the original Deptford station. In the following year he was in the employ of the Thomson Electric Welding Co., of Lynn, U.S.A., later joining the Thomson-Houston Electric Co., of Lynn, Mass., as an electrical engineer. In 1891 he was appointed manager of the meter department of that company, and upon its consolidation with the General Electric Co. he took charge of the engineering and manufacturing of electrical instruments and meters. Mr. Haskins organised and became commander of a corps of electrical engineers which rendered valuable service in the Spanish-American war. His technical knowledge was also utilised in harbour and coast defence—indeed, his experience on the applications of electricity for defence in time of war was such that he frequently acted in an advisory capacity for the U.S.A. Government in matters of this nature. Eleven years ago he took charge of the G.E. electric switchboard department, and in 1906 received the appointment of manager of the company's lighting department. He was well known as an author and lecturer, and was a member of a number of American electrical and engineering societies.

THE MARQUESS OF TWEEDDALE, K.T.—We record with deep regret the death of the Marquess of Tweeddale, who passed away in London on Saturday last, at the age of 85 years. Lord Tweeddale was one of the leading men in the realm; not only was he of great distinction by lineage, but he had in the course of his very lengthy career figured in public in India, and in the House of Commons at home. In the City he had for many years been a familiar figure at the meetings of submarine telegraph companies, over which he always presided with courtliness and grace, and his continuance in office, in spite of the increasing infirmity of advanced years and his inability to hear, well show his sustained interest in telegraph matters. The companies with which he has been associated, either as chairman or director, include the following:—The Eastern, Eastern Extension, and Eastern and South African Telegraph Companies, the Europe and Azores Telegraph Co., West African Telegraph Co., Direct Spanish Telegraph Co., and the Globe Telegraph and Trust Co., Ltd.

An Australian exchange announces the death, from heart failure, quite unexpectedly, at the age of 68 years, of MR. NORMAN SELFE, M.Inst.C.E., M.I.M.E., a consulting engineer, who had been well known in Sydney, N.S.W., for many years.

NEW COMPANIES REGISTERED.

Hadley Engineering Co., Ltd. (118,777).—This company was registered on November 25th, with a capital of £250,000 in £1 shares (150,000 6 per cent. cumulative preference), to acquire and combine several kindred manufacturing businesses hitherto carried on (1) by Joseph Sankey and Sons, Ltd., at Hadley, near Wellington, Salop; (2) by Thomas Tilling, Ltd., at Peckham, S.E., and (3) by W. A. Stevens, Ltd., at Maidstone. The subscribers (with one preference share each) are: R. S. Tilling, Winchester House, Peckham, S.E., chairman, Thomas Tilling, Ltd.; E. W. Tilling, Winchester House, Peckham, S.E., director, Thomas Tilling, Ltd.; W. Wolsey, jun., Winchester House, Peckham, S.E., director, Thomas Tilling, Ltd.; W. A. Stevens, 26, Victoria Street, S.W., and St. Peters Street, Maidstone, director of W. A. Stevens, Ltd.; J. W. Sankey, Foxhills, Wombourne, Staffordshire, chairman of Joseph Sankey and Sons, Ltd.; G. H. Sankey, Finchfield House, Wolverhampton, director of Joseph Sankey & Sons, Ltd; F. E. Sankey, Waterdale, Wolverhampton, director of Joseph Sankey & Sons, Ltd. 120,000 preference, and not more than 13,000 ordinary shares, are offered for subscription; subscribers for preference shares have the right to apply at same time for ordinary shares equal to not more than 10 per cent. of such preference shares; minimum cash subscription, 25 per cent. of the shares offered to the public. The number of directors is not to be less than three or more than seven; the first are G. H. Sankey (chairman), W. Wolsey, jun., and W. A. Stevens; qualification, £500; remuneration, £150 each per annum, and £150 extra for G. H. Sankey, as chairman. Preference shares confer no rights to attend or vote at meetings except under special circumstances. No debentures may be issued without the sanction of preference shareholders. Solicitors, Underhill, Thorneycroft and Smith, Wolverhampton; general manager, S. L. Brunton, M.Inst.C.E., M.I.E.E., secretary (*pro tem.*); and registered office, W. S. Clarke, 1-2, Great Winchester Street, E.C.

Automatic Telephone Manufacturing Co., Ltd. (118,664).—This company was registered on November 20th, with a capital of £1,000,000 in £1 shares (500,000 preference), to carry on the business of manufacturers of and dealers in (so far as may be lawful) automatic and other telephones, telegraphs, wires, cables, and lines of all kinds, electricians, mechanical engineers, suppliers of electricity for light, heat and power, &c., to acquire from the Automatic Electric Co., of Chicago, certain patents relating to automatic telephones; also to acquire from the British Insulated & Helsby Cables, Ltd., certain freehold lands at Edge Lane, Liverpool, together with the works and plant, &c., thereon and goodwill of business carried on there, and to adopt agreements *(a)* with the Automatic Electric Co., of Chicago, and *(b)* and *(c)* with the British Insulated & Helsby Cables, Ltd., the *(c)* agreement relating to the guarantee of the preference dividend of 200,000 of the company's preference shares. The subscribers (with one share each) are:—J. Taylor, Heathercliffe, Helsby, manufacturer; D. Sinclair, The Grange, Huyton, electrical engineer; A. Brooker, Ashfield, Huyton, electrical engineer; J. S. Harmood Banner, 24, North John Street, Liverpool, chartered accountant; F. E. V. Russell Roberts, 10, Water Street, Liverpool, solicitor; V. D. Heyne, 10, Water Street, Liverpool, solicitor; J. Bruce, 10, Water Street, Liverpool, clerk. Minimum cash subscription 10 per cent. of the share capital offered to the public. The number of directors is not to be less than five or more than seven; the first are J. Taylor, D. Sinclair, J. S. Harmood Banner, E. A. Mellinger, 1,001, Van Buren Street, Chicago, U.S.A.; J. B. Russell, 46, Wall Street, New York; and M. Muspratt, 12, Fulwood Park, Liverpool; qualification, £1,000; remuneration, £400 per annum (chairman £450). Registered by Bower, Cotton & Bower, 4, Bream's Buildings, E.C.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

THE directors' report which is to be presented at the meeting in London on December 4th, states that during the year ended August 31st, 1911, they have continued their policy of energetic development, and have expended a further sum of £52,554 on capital account in the provision of additional land, buildings, plant and mains. For the purpose of providing the necessary additional capital to continue such development and to keep pace with the remarkably rapid growth of the undertaking, and in pursuance of authority obtained from meetings held in May last, £100,000 5 per cent. debenture stock was offered for subscription at par and allotted in full on June 2nd. The profit and loss account shows a credit balance for the year of £40,983. After payment of the dividend on the preference shares for the half-year ended February 28th, 1911, and of an interim dividend of 3s. 6d. per share on the ordinary shares, and after writing off the cost of the debenture issue, as well as the cost of the stamp duty and other charges in respect of the increase in the authorised amount of the share capital as sanctioned at the last annual general meeting, there remains, including the amount carried forward from the previous year, an available balance of £31,635, which the directors recommend should be applied as follows:—Dividend on 30,000 6 per cent. preference shares for the half-year ended August 31st, 1911 (paid on September 1st, 1911), £4,500; final dividend of 6½ per cent. on 30,000 ordinary shares, making 10 per cent. for the year, £9,750; bonus of 2s. per share on 30,000 ordinary shares, £3,000; transfer to general reserve, £5,000; transfer to dividend equalisation account, £5,000; carrying forward, £4,385. The directors further recommend that the above-mentioned final dividend and bonus should be paid free of income-tax. The directors point out that the profits of the company during the last three years have been materially increased in consequence of the large amount of power supplied to the Adelaide Municipal Tramways Trust, pending the completion of the Trust's own power house. During the last few months of the company's financial year, this supply was gradually reduced as the Trust became able to generate its own supply; and before the close of the year the revenue from this source had practically ceased. In consequence of this, the directors again recommend that a portion of the profits be transferred to a dividend equalisation account. The officials of the Tramways Trust have publicly acknowledged their indebtedness to the company for the satisfactory supply which it maintained in circumstances of considerable difficulty. Such supply was only rendered possible by the expenditure of a large sum in additional plant and machinery. The following table sets out in detail the progress made by the company during the past four years:—

Date.	Lighting in 30-watt lamps.	Motors in rated H.P.	Total in 30-watt lamps.	Total units sold.
August 31st, 1908	71,138	1,637 H.P.	129,922	1,666,974
August 31st, 1909	91,338	2,369 H.P.	167,146	2,073,550*
August 31st, 1910	112,154	3,101 H.P.	211,386	2,538,062*
August 31st, 1911	147,094	3,986 H.P.	274,586	3,390,580*

* Excluding traction units sold to the Municipal Tramways Trust.

In view of the largely increased work of auditing the local accounts, the Local Board advise the appointment of Mr. W. E. Dalton, of Adelaide, as an additional auditor of the Adelaide accounts.

Castner-Kellner Alkali Co., Ltd.—The Right Hon. G. W. Balfour presided at the annual meeting at Cannon Street Hotel, E.C., on November 23rd, and in moving the adoption of the report, he said that the profit had been higher than the company had ever earned before (£178,853). With the final dividend they paid in all 20 per cent. on the shares, and carried £1,422 forward. There was no serious cloud on the horizon, but he thought that having in view how essentially precarious an industry the chemical industry was, the Press had been too optimistic regarding their future. Apart from the possibility of labour troubles, they could look forward to a prosperous year. The report was adopted.

Nairobi Electric Power and Lighting Co., Ltd.

THE directors report that the accounts for the year 1910 show that the progress of the company's affairs has been even more satisfactory than was predicted at the last annual meeting, and the progress is well maintained up to date; there appears to be every likelihood of its continuance in the future. The following comparative figures will be found of interest:—

	At Dec., 1909.	At Dec., 1910.	At June, 1911.
Number of customers connected	178	257	312
Motors connected, B.H.P.	64	147	160
Lights connected, 8-C.P. equivalents ..	3,628	5,782	6,715
Street lighting " " ..	nil	2,000	2,000

The managing director has visited England during this year, and returned to Nairobi on November 9th. Mr. Chas. Udall, the chief engineer, whose agreement for service expired in July last, has been re-engaged for a further term of service at Nairobi. Since the last annual meeting the directors have elected Mr. A. W. Mayo-Robson, C.V.O., D.Sc., to a seat on the board. Mr. W. H. Hooker resigns his seat on the board.

Prospectuses.—*Automatic Telephone Manufacturing Co., Ltd.*—This company's prospectus is before the public as we write, and the list of subscriptions is to close on Monday next. The nominal capital is £1,000,000 in £1 shares, one half of them 6 per cent. cumulative preference and one-half ordinary shares. The promoters, the British Insulated and Helsby Cables, Ltd., are offering 200,000 of the preference, and 100,000 of the ordinary for subscription, and they guarantee absolutely the payment of the dividend on the 200,000 preference shares now offered, until the general reserve fund of the Automatic Telephone Manufacturing Co., Ltd., shall amount to £100,000. The company has been formed to manufacture automatic telephone apparatus on the Strowger system, to a demonstration of which in London, by the British Insulated and Helsby Cables, we referred on page 871 of our last issue. It is estimated that the works erected by the British Insulated at Edge Lane, Liverpool, in 1903, will, by an outlay of £50,000, be able to undertake, in addition to the general telephone trade, the manufacture of the complete automatic apparatus for 100,000 telephones in the year. It is estimated that the capital now offered for subscription will leave, after providing for the portion of purchase price payable in cash, the formation and other expenses, and for the additions to the works, further working capital of not less than £75,000. The price to be paid to the Automatic Electric Co., of Chicago, for assets particularised in the prospectus, is £240,000 (£100,000 in cash, and £140,000 in ordinary shares). The price payable to the British Insulated and Helsby Co. is £170,000, payable as to £50,000 in cash, and £120,000 in ordinary shares. The amount payable for the goodwill of the Edge Lane Works has been fixed at £30,000. The particulars of the registration of the company appear in the preceding column.

The Hadley Engineering Co., Ltd.—This company is offering for subscription, until December 4th, 120,000 6 per cent. preference shares, and not more than 12,000 ordinary, all of £1 each. The company is to combine the businesses of Joseph Sankey & Sons, Ltd., of Hadley, Shrops., makers of wheels, bodies and other parts for motor vehicles; Thomas Tilling, Ltd., Peckham, makers of the Tilling-Stevens chassis for motor-omnibuses and mail vans; and W. A. Stevens, Ltd., Maidstone, makers of the Stevens patent electric transmission equipment for motor vehicles. It is claimed that the amalgamation will enable the vehicles to be built rapidly and at low cost. A report by Mr. W. M. Mordey (Mordey and Dawbarn, consulting engineers) on the Hadley Works, and on the Tilling-Stevens system accompanies the prospectus, which appears in our advertisement pages to-day. The purchase price for the Sankey business, &c., is £105,000 (£25,000 in cash, £30,000 in fully-paid ordinary shares, and £50,000 in fully-paid preference shares, or in cash). The purchase price payable to W. A. Stevens is £12,000 (£11,000 cash and £1,000 in ordinary shares). To Thomas Tilling, under an agreement which is detailed, £5,000 is payable in ordinary shares. It is anticipated that the profit on the combined businesses will, from the first, suffice to pay the dividend on the preference shares now offered, leaving £12,800 for ordinary dividend and reserve. Subscribers for preference shares are allowed to apply for up to 10 per cent. of that amount in ordinary shares.

Montreal Street Railway Co.—The directors' report states that the gross earnings for the year to September 30th increased $422,749, or 9·71 per cent., the operating expenses $224,505, or 9·14 per cent., and the net earnings $198,245, or 10·15 per cent. The gross earnings (says the *Financier*) continue to show very satisfactory increases. The ratio of expenses to gross earnings is 56·12 per cent., against 56·41 per cent. for the previous year. During the year the company secured an amendment to its charter authorising the sale, lease or transfer to any person or company of all its undertakings, upon such terms as might be approved by the majority of the shares. On October 5th last a special general meeting of the shareholders was held for the purpose of considering the sale of the whole of the undertakings to the Montreal Tramways Co. The proposition was carried by the majority of the issued shares. It is hoped that the amalgamation of this company with its subsidiary companies under the name of the Montreal Tramways Co. will help to speedily complete the negotiations for a new franchise, more applicable to present-day conditions. The company has paid to the city of Montreal taxes and percentage on earnings amounting to $380,679, and on account of snow removal $73,365, a total of $454,044, being an increase over the previous year of $15,993.

British Columbia Electric Railway Co., Ltd.

THE fourteenth annual report, which was submitted at the meeting held yesterday at the Abercorn Rooms, Liverpool Street Hotel, E.C., states that for the 12 months to June 30th, 1911, the gross receipts show an increase of $1,323,028, or 43 per cent., and the net earnings, including income from investments and subsidiaries, and after charging renewals, show an increase of $369,521, or 34 per cent., over the preceding year. From June 30th, the close of the financial year under review, up to September 30th last, there has been a still further increase in gross earnings of $401,783, or 45 per cent., and in net earnings of $63,282, or 17 per cent. During the whole of the 12 months under review an exceedingly large sum of capital has been involved in various works and extensions under construction, and has consequently remained unremunerative. The company will derive a considerable increase in its earnings from these works and extensions as they are completed. The following charges have been made against the revenue account of the year, viz.: Provision for renewals maintenance (from which £32,022 has been deducted for adjustments and expenditure on renewals during the year) £76,136, amount written off old steam plant £10,000, amount added to capital amortisation fund £2,183. The net profit for the year, after making the above deductions, amounts to £281,126, plus £5,607 brought forward, making £286,733. There are then deducted: Interest on debentures and debenture stock to June 30th £82,670, dividends already paid, on 5 per cent. cumulative perpetual preference stock for the year £35,000, on preferred ordinary stock for the year £42,000, on deferred ordinary stock for six months to December 31st, 1910, £32,000, leaving available for further distribution and reserves £95,062. From this the directors recommend a dividend on the deferred ordinary stock at the rate of 8 per cent. per annum for the last six months, making 8 per cent. for the year, £32,000, transferring to reserve fund £56,472, and carrying forward £6,590. There has been deducted from the reserve fund £20,862, representing the difference between the net amount realised by, and the par value of, £600,000 4½ per cent. debenture stock, issued in March last, and there has been added to the reserve fund £53,994, representing the premium on £600,000 new capital, less expenses, issued in November, 1910. After the transfer now recommended by the directors as above, the reserve fund will amount to £337,000.

In December Mr. Blundell Brown visited New York on behalf of the company in connection with important negotiations. During last summer three of the directors, Mr. G. P. Norton, Mr. Harold G. Brown and Mr. E. Maes Harvey, made a prolonged visit to British Columbia in order to study local conditions and inspect the company's property. They were greatly impressed with the remarkable progress and development throughout the Province of British Columbia, and were satisfied that for some years this development must continue. The report proceeds to quote interesting figures taken from the President's address to the Vancouver Board of Trade in March last, showing the rapid developments that are taking place.

A large amount of construction work has been carried on during the year, not only in new developments, but in extensions of the existing railway, lighting and power systems. A large terminal station and central offices, necessary to meet the requirements of business, are also in course of construction in Vancouver City, and a handsome new station was recently opened in New Westminster. The growth of the company's business is indicated by the following figures:—Miles of track in operation: 1909, 97·74; 1910, 141·65; 1911, 233·65. Total cars of all classes: 1909, 248; 1910, 427; 1911, 647. The number of passengers carried during the year was 46,541,448, an increase of 12,064,644. The number of lamps in use at June 30th, 1911, was 563,542, an increase of 124,227. A satisfactory feature of the year's business is the growth of the revenue received from the new suburban lines.

During the year great dislocation of traffic and large expense to the company has been caused by the large amount of street paving and improvement that has been undertaken by the cities of Vancouver and Victoria. This has not only adversely affected the company's profits, but has caused much irregularity in the service and consequently great inconvenience to the public.

Considerable progress has been made with the construction of the dam at Coquitlam, an undertaking which is the largest of its kind in Canada. This dam, when completed, will be 90 ft. high and contain about 554,000 cb. yards of earth work, and by its means the level of Coquitlam Lake will be raised 60 ft., rendering 54,000 million imperial gallons of water storage available for power purposes. The enlargement of the tunnel between Lake Coquitlam and Lake Buntzen, which has been in progress during the last two years, has been successfully completed. This tunnel, 12,775 ft. in length, originally had a cross-sectional area of about 81 sq. ft., and has been enlarged to 172 sq. ft., thus increasing its capacity three times. It is now possible to bring up the power at Lake Buntzen to upwards of 70,000 H.P., which will be available to meet the rapid growth of the demand in Vancouver.

There is at present being installed at the power house a third 10,000-H.P. water wheel, which it is hoped will be ready for operation in December, bringing the capacity of the plant at the power house up to 42,000 H.P. Plans are now being prepared for a large extension of the power house and the provision of two new 15,000-H.P. turbine units. In addition, the company have in progress an extension of the auxiliary steam plant, which has been provided for temporary breakdowns on the transmission lines, bringing the capacity of the steam plant up to 12,000 H.P.

Plans have now been filed with the Government for the construction of plants for the utilisation of the company's water powers at Lillooet and Jones Lake, Chilliwack. The board have a carefully considered scheme for the provision of power to meet the requirements of the company in future years. On Vancouver Island the installation of a water power at Jordan River has been satisfactorily completed, and there should shortly be available a sufficient quantity of power to meet the increasing demands of the city of Victoria and district. The company has commenced the construction of a line of about 20 miles in length from Victoria through the fertile Saanich Peninsula, and it is generally expected that this line will considerably augment the growth of the undertaking in Victoria, which, during recent years, has been making rapid strides. Towards the end of 1910 the directors were asked by the Mayor and Corporation of Vancouver to consent to a unification of the franchises, under which the company operates its railway business in various parts of the city and suburbs, with a view of facilitating the consolidation of the city and the various separate suburban municipalities which surround it into one great city.

The directors consented, in order to meet the wishes of the citizens of Vancouver, to enter into an agreement whereby the municipality would have obtained the right to purchase the company's railway lines within the extended limits of the new city in 1934, but in the negotiations that followed, some of the representatives of the city endeavoured to introduce restrictions of a general nature, to which the directors could not see their way to agree, and, in consequence, no arrangement has been concluded. The company operates its line within the narrow boundaries of the old city under statutory powers and subject to an agreement renewable in 1919 for successive periods of five years, until the city determines to buy the railway property within the old city limits. The price, in the event of dispute, is to be fixed by arbitration. In fixing the purchase price, the arbitrators are to take (*a*) the then market value of all lands to be taken over, and (*b*) the value of all improvements, buildings and machinery then made, affixed or erected on the said lands, and of the personal property to be taken over, which values shall be arrived at by taking the cost to the company, including the cost of constructing the railway lines and of installing all the plant and machinery, and deducting therefrom a reasonable sum for depreciation. The portion of the company's railway which the Corporation of Vancouver will be entitled to purchase represents 49 miles out of a total of 234 miles operated by the company. Should the city exercise this right the company will retain various lines of entry into the city in perpetuity or for a long period of years. The whole of the remaining lines are operated under franchises extending over periods of not less than 36 years. The company's business has during the last few years developed to such extent, particularly in the outlying districts, that the receipts from the railway lines within the old city limits are no longer such an important part of the whole receipts of the company as they were, and are steadily becoming a smaller proportion of the whole. The lighting franchises are either perpetual or for a very long period of years.

To prepare for handling a greatly extended and increased volume of business in the future, the directors, after consulting with the general manager, thought it advisable to engage additional expert assistance, and decided to associate with the management several highly qualified officials to take charge of important departments, now rendered necessary by the magnitude of the company's business. During the year the directors have received, with great regret, the resignation of Mr. Francis Hope, for many years secretary of the company in London and assistant general manager in Vancouver. Mr. Hope served the company during the whole period with great devotion and ability, and has resigned his post for family reasons. The directors have again pleasure in expressing their appreciation of the very satisfactory services rendered by the management and staff in British Columbia.

Year ended June 30th.	Gross earnings.	Net rev. inc. investments income.	Passengers.	Lamps in use.	Balance available for dividend.	Pref. ord. stock, div. per annum.	Def. ord. stock, div. per annum.	Amount to reserves.
1909 ..	£478,146	£190,444	25,183,739	347,026	£123,417	6 %	8 %	£65,093
1910 ..	628,763	226,873	34,476,804	439,315	139,391	6 %	8 %	108,265
1911 ..	901,553	302,993	46,541,448	563,542	198,455	6 %	8 %	158,571

Cordoba Light, Power and Traction Co., Ltd.

SIR J. IRVING COURTENAY (chairman) presided, on November 22nd, at the offices, 62, London Wall, E.C., over the third annual meeting of the above company.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 837), the CHAIRMAN said he thought they might congratulate themselves on the results shown. This was the third annual general meeting, and their progress had, he thought, been satisfactory. In their first year they made a net profit of £13 400, and paid a dividend of 2 per cent. In their second year the profit earned was £17,500, and they paid a 3 per cent. dividend. The accounts before them showed a profit for the year of £19,900. and they were enabled to recommend a dividend of 4 per cent. They hoped that after the construction work of their subsidiary companies was completed and in full operation, and with a fair supply of water, they would be able to report further substantial progress in the profits. Dividends had been declared by both the subsidiary companies in respect of their year to March 31st last, but the dividend on the common stock of the Light and Power Co., which was not paid until 1st inst., and which on their holding of common stock represented £3,205, was not included in the profits for their year to September 30th last, but would be taken into the accounts for the current year. He had not a great deal to say that day regarding their business, as they met only about four months ago. The progress made with the construction work had continued to be satisfactory. It was true that when they met a year ago he mentioned that, as far as they could then judge, the first portion of the power from the new Calera works would be available by about September. It was not yet ready, but they expected to hear before the end of next month that it was at work. One reason for the delay was the fact that, owing to the scarcity of water, they were not able to supply their contractors with as much electrical energy as they required for the construction work. One satisfactory and, he might say, most unusual point regarding this construction work was that the Calera hydraulic station, transmission lines, transformer station and other works incidental thereto would cost considerably less than was originally estimated. This was in part due to a cause which had, in other respects, been one of great anxiety to the directors. That was the emptying of the San Roque dam by the Government engineers, and the consequent scarcity of water in the river during the dry season. The dam was emptied for repairs at the end of August, 1910. They were advised that the work had been completed by November 3rd, 1910, but for one reason or another the whole of the repairs were not actually completed until May, 1911. In consequence the bulk of the rainfall during the wet season was lost, and they were left with very little water until August last, and were obliged to have recourse to the steam plant for the generation of the electrical energy. This had greatly increased the operating expenses of the Light and Power Co., and also necessitated for a time the cutting-down of the tramway service. However, what had been lost in revenue was, he was glad to say, more than

made good in the reduction in the cost of their new plant. This did not mean that they had these savings in hand. As they had previously explained, the growth of both the lighting and the tramway businesses had required further extensions of plant, for which they had raised the funds by means of the promissory notes referred to in the balance sheet. As regarded the construction of the tramways, they were now approaching the completion of the programme covered by their new concession, and would shortly have the whole 29 miles converted. The operation of that part which was in service was quite satisfactory. Notwithstanding the comparatively small amount of track which had been open, the difficulties with regard to power and the continuance of horse service on certain routes, the net receipts of the Tramways Co. for the six months to September 30th last showed an improvement of 16½ per cent. over those of the corresponding period of the previous year. They hoped soon to complete the electrification and to suppress the horse traction entirely. The business was advancing, the extensions upon which they had been engaged for the last three years were fast approaching completion, and they could look forward with confidence to the continued prosperity of the company. The latest report stated that 19½ miles were now open for public service by electric traction.

MR. FRAME THOMSON, in seconding the motion, said they had been fortunate in having been able more or less to follow the programme anticipated when the company was formed, viz., that they should make a start with a small dividend of 2 per cent., and increase at the rate of 1 per cent. per annum. They had been able to do that up to now, and unless some unforeseen difficulties transpired, it was extremely possible they would be in an improved condition next year. So far they had had a month of the present wet season, and the level of water in the dam was quite up to the usual. They had three or four months of the wet season to come, so that when they got the Calera works in full working order, they ought to be able to work economically. They had a slight competition to face, for there was a company already supplying electric power, but as that company depended almost entirely on coal for the generation of power, he looked on it as being more in the nature of a healthy stimulation to their efforts than any impediment to their progress. They were now getting over the transitory stage, and the many difficulties which they had overcome were a good augury that they would be able to face any difficulties which might arise in the future.

The resolution was then carried, and a vote of thanks accorded to the board.

British Electric Traction Co., Ltd.

MR. E. GARCKE (chairman) presided on Wednesday last week at the Cannon Street Hotel, E.C., over an extraordinary general meeting of the above company for the purpose of considering and, if thought fit, confirming certain resolutions to alter the articles of association, and further to consider the resolutions converting the preference and ordinary shares.

The CHAIRMAN said the first resolution was to confirm a resolution for the alteration of the articles, and the second resolution dealt with the amended scheme. At the extraordinary meeting held on November 3rd, the amended scheme for the rearrangement of the capital was carried by a large majority, and it was decided to adjourn the meeting and also the separate class meetings. Since then they were advised by counsel that it would be better, in view of the material alterations which the amended scheme contained, as compared with the scheme for which the first proxies were obtained, to hold fresh meetings and issue fresh proxies, and this had been done. The scheme now submitted was the same scheme as that submitted on November 3rd, but he would ask them to make two or three verbal alterations in the resolution. He could not say anything further in support of the resolution beyond what he stated at the last meeting. He then explained the cause which had led the directors to submit the amended scheme, and the reasons why the original scheme could not be proceeded with, and he thought he explained fully and accurately the effect which the amended scheme had upon the existing preference shares and ordinary shares respectively. Moreover, the arguments for and against the scheme were fully stated by others in the course of the discussion at the last meeting. They had received proxies from over 1,200 shareholders in favour of the amended scheme—new proxies he meant—and only one proxy against the scheme from a holder of 39 preference and 4 ordinary shares. In these circumstances, he did not think it was necessary that he should detain the meeting by again stating the reasons why they recommended the scheme for adoption, although they were prepared to give any explanation which might be asked for. There was one technical point which had arisen. In the first statement of the amended scheme, they explained in a footnote how they proposed to deal with the unissued capital of the company. They were proposing to divide the £4,000,000 authorised capital into £500,000 cumulative preference stock, and £1,000,000 non-cumulative preference stock, £1,500,000 preferred ordinary stock, and £1,000,000 deferred ordinary stock, each of which would include a margin of unissued capital. But they were advised by the lawyers that although this could be done if the intention were to issue shares, it could not be done now that they proposed to issue stock, because unissued shares could not be converted into unissued stock. To get over the difficulty they proposed to convert the whole of the unissued capital into ordinary shares, with power to the company to convert them into other classes if so decided by a special resolution. It was not thought desirable to cancel the unissued capital, as it would necessitate the payment of a considerable amount of stamp duty in the event of the company being hereafter required to do so. The chairman concluded by moving the resolution.

SIR R. HAMPSON seconded the motion.

After brief discussion, the resolution was carried by 38 votes to 12.

At the subsequent meeting of preference shareholders 19 voted for the resolution and 13 against, and consequently the requisite majority was not obtained, and a poll was demanded.

The CHAIRMAN said they had received proxies for 39,930 preference shares in favour, and only one of 39 shares against.

A meeting of the ordinary shareholders passed the resolution unanimously, and then a poll was taken of the preference shareholders, and the resolution was carried.

Manaos Tramways and Light Co., Ltd.

MR. G. M. BOOTH presided at the offices, 9, Cloak Lane, E.C., on Friday last, over the second ordinary general meeting of this company.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 874), the CHAIRMAN called attention to the fact that the accounts had this year been closed at the exchange of 16d. per Brazilian milreis, whereas last year's accounts were closed at 15d. This alteration gave them a direct additional profit of about 7 per cent., and it was not a book-keeping addition, but an actual one. During the year under review exchange was continuously at or above 16d., and the Brazilian Government had altered the legal rate of exchange from 15d. to 16d., and it was in accordance with this improved basis that their accounts had been closed. As they received their income in milreis in Brazil, remitting the surplus to London, this higher rate of exchange was obviously much to their advantage. Referring to the revenue account, their gross tramway receipts had increased from £78,169 to £105,867; the gross lighting receipts had increased from £27,866 to £33,594, and the total gross income had increased from £106,854 at 15d. to £139,938 at 16d., an actual increase, after allowing for exchange, of 22 per cent. in the business. The operating expenses had remained high during the year, but the net earnings had increased from £18,895 to £29,862, or a total increase of 58 per cent., while the ratio of operating expenditure fell from 82½ per cent. for last year to 78½ per cent. for this year. During the whole of the year under review construction work was going on, and the company's services were interfered with by the necessities of this work. The cost of new construction work carried out during the year amounted approximately to £40,000, and with this expenditure the construction included in the original programme was completed by April 30th, 1911. Although the operations of the company did not, for the reasons just given, reach a normal stage last year, the balance of profit, after the payment of all London expenses and providing for income-tax and debenture interest, amounted to £12,446. The directors, however, considered that the time had not yet come to commence the payment of dividends, and that the interests of all of the security holders would be best served by placing to a reserve account practically the whole of these profits. Accordingly they would notice from the appropriation account that £10,520 was being added to the contingent reserve, while the amount carried forward to the credit of profit and loss account was increased by £1,926 to £3,509. They trusted that the shareholders would all concur with the directors in the belief that at this early stage of the company's existence this conservative policy was essential, in order that once the payment of dividends was begun the company's position would be strong enough to make continuance at a good rate reasonably assured. There was one further point that he would mention in connection with the balance-sheet, viz., that the sum of £3,020 for accident claims paid out during the year was charged against the contingent reserve set aside in last year's accounts. During the period of reorganisation and reconstruction the company had had a rather large number of accident claims to settle, and under the procedure in Brazil, it was frequently many months after the accident before the settlement was made. This £3,020 was all paid on account of accidents which occurred in 1908, prior to their taking over the property; accidents which occurred, and which had been settled during the current year, had been charged direct to the operating accounts for the year. There were still outstanding a few accident claims on which the company was now negotiating settlements, and which similarly would in next year's accounts be charged against the contingent reserve. As soon as the board had reliable statistical evidence of the amount they might have reasonably to pay year by year by way of compensation for accidents, they would advise the adoption of the practice usual with all tramway companies of setting aside an annual amount to a specific accident reserve account. For the last 19 months no serious accidents had occurred, and current claims, which were not of serious moment, were being settled promptly. They trusted, therefore, that in future reports this item would not be an important one. The general business conditions in Manaos during the latter part of the year, ended April 30th, 1911, were not at all satisfactory. As they all knew, there had been a very considerable drop in the price of rubber, and rubber was practically the sole article of export from Manaos. While the present price of rubber was only about one-third of that ruling 18 months ago, it was a price at which rubber could be produced profitably and in large quantities in the Amazon Valley. So serious a fall in price, however, required much readjustment in local business circles, and had produced a severe local financial crisis. That the company had been able to show so large an increase, both in gross and in net earnings, in spite of this crisis, was a matter for congratulation, and an indication that with the business recovery,

which was sure to occur, the company would enjoy increased prosperity. He was glad to be able to tell them that during the first six months of the current year, that was to say from May, 1911, although the rubber crisis had continued, their earnings had registered steady increases, and the returns for these six months showed an increase of net earnings of approximately £7,000 over the corresponding months of last year. As he had said before, reconstruction work was going on throughout the year, and the full benefit of the new capital expended on the undertaking had not yet been realised. This benefit would accrue in the year now current and in future years. They had now on order additional material to increase the public lighting by 50 arc lamps; further extensions of mains would be needed, and they had found it necessary to order four large cars. The construction work of the future, however, would not disorganise their operation, and such expenditure would be incurred only as required by the development of the system. On the whole, the directors felt that they were to be congratulated on the satisfactory results of the past year, bearing in mind the adverse conditions under which those results were obtained, and they looked forward with confidence to the future of the company, anticipating continued expansion of the earnings. It was never wise to prohesy as to when dividends could be recommended. They would t recommend their payment until they felt fairly confident of eir permanence, but they hoped that when they met next year they ould be able to feel satisfied to make a start in that direction.

MR W. C. BURTON seconded the motion, and the report was adopted without discussion.

Barbados Electric Supply Corporation, Ltd.

THE directors' report to June 30th, 1911, states that it was expected that the construction would have been completed early in the current year, but the work was delayed, and it was only at the end of June that a supply was commenced. Since the close of the period to which the report refers, considerable progress has been made in connecting consumers to the mains. Mr. W. C. Kenny, a director of the Royal Mail Steam Packet Co., joined the board in June, 1910.

The first ordinary general meeting was held at the offices, Basildon House, Moorgate Street, E.C., on Monday, Mr. A. W. Tait presiding.

The CHAIRMAN, in moving the adoption of the above report, said as they were aware the company was formed to construct and operate at Bridgetown, in the island of Barbados, an electric power supply system pursuant to an order granted by the Government of Barbados. This order gave to the company the exclusive right to supply electric energy for lighting and domestic purposes within the City of Bridgetown and its environments for a distance of 5 miles from the limits of the city, for a period of 42 years from 1907. In May, 1910, the company made an issue of 7 per cent. preferred and participating shares to provide the necessary funds to install the system. In the prospectus it was stated that the engineers anticipated that the works would be completed in eight months from the time they were put in hand. Some time naturally elapsed in fixing up the contracts, but these were finally settled and the engineers proceeded to Barbados in July, so that under the estimate the work should have been completed about the end of March, 1911, but the supply was only commenced at the end of June, and the whole of the construction of that originally planned was not completed until about the middle of September. There were various causes which contributed to this delay, and one of the chief was the usual difficulty experienced of getting contractors to keep the promised dates of delivery. Another thing, which might seem somewhat trivial, but in reality proved of much trouble, was the difficulty experienced by the general manager in getting sites for their poles. This would require some explanation to those who were accustomed to see well-laid-out streets in big cities. The streets of Barbados through which their overhead mains passed very frequently had no footpaths at all, and as they were not permitted to place the poles in the gutters, it was necessary in many instances to make arrangements for the erection of poles on private property, which in some cases necessitated the consent of two or three different parties. As he had said, the work originally contemplated was completed about the end of September, and they had already received the return of one-half of the deposit made under the terms of the order, and expected that by this time the balance would had been received. It had been thought necessary to authorize extensions of the original lay-out of mains, and no doubt it would be necessary to make more or less constant additions, but the additions at present contemplated were not of an expensive nature, and did not require much capital outlay. They were able to get the plant running in time to assist the illumination of the town for the King's Coronation, but no actual supply to consumers was commenced until July. This was due to the fact that the work of wiring and fitting consumers' premises was not completed earlier. This work was now proceeding rapidly, but the general manager complained that he had experienced difficulty in training the local workmen. No doubt as time went on these men would become more proficient in the work. They had also been hampered somewhat in the last summer by the labour unrest in this country, which caused delay in the delivery of the necessary wiring and fitting material, because even after the strike there was considerable congestion of the railway and steamship routes for some time. According to the report received from the general manager, there were connected to the mains in the month of October the equivalent of 723 25-C.P. lamps, and motors and fans giving a load equivalent to 607 25-C.P. lamps, or a total equivalent to 1,330 25-C.P. lamps, while the number of consumers was 60. The general manager in Barbados anticipated that by the end of the year there should be connected to the mains for lighting purposes only the equivalent of 4,000 25-C.P. lamps. This figure was a long way behind that mentioned in the prospectus, which gave the probability of 10,000 16-C.P. lamps, but he had no doubt that this would ultimately be reached and probably exceeded, although they had to meet the keen competition of the gas company. There was also a fair number of small power consumers in the neighbourhood of Bridgetown. They were supplying current to one or two of these, and the manager was in negotiation with others, who were no doubt waiting to see the results of the motors already installed, and if they were successful, as was anticipated, a considerable number of further consumers would be obtained in this way. They would see that of the authorised issue of 40,000 7 per cent. preferred and participating shares, 32,521 had been issued at the date of the accounts, leaving a balance of 7,479 unissued. With regard to the completion of construction, some of the contractors had agreed to subscribe at par for a portion of the balance, and when these shares had been issued there would be available for the purposes of the company a balance of approximately 5,000 shares. The items of sundry creditors and credit balances stood at £5,590, and represented principally retentions on contracts and a substantial proportion of this amount would be set off against the subscriptions for shares. The property account amounted to £50,403, and included the cost of the Lighting Order, viz., £20,853, of which £20,000 was paid in fully paid ordinary shares of the company. The balance of the amount represented the expenditure on the purchase of land for the power house buildings, the erection of the power house, machinery and plant, feeder cables, distributing mains, transformers, consulting engineers' fees, &c. The plant at the power house consisted of two Diesel oil engines of 200 H.P., direct coupled to two generators of 135 KW. capacity. So far, the plant had worked without hitch or trouble, and the directors believed the installation of the oil engines would enable them to show economical costs for the generation of power. To provide additional working capital, a temporary loan of £3,000 for two years at 6 per cent. had been arranged with the Anglo-American Debenture Corporation, and if the business continued developing, it might be necessary to increase the amount of this loan. The chairman proceeded to refer to the work done by the local directors, and to the thanks they owed the general manager, Mr. W. C. Shettle.

MR. W. C. KENNY seconded the motion for the adoption of the report, which was agreed to without discussion.

A vote of thanks was accorded the board on the motion of MR. SALMON.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Brush Electrical Engineering Co., Ltd.—£97,708 5 per cent. prior lien debenture stock.

Buenos Ayres Lacroze Tramways Co., Ltd.—Further issue of £50,000 5 per cent. extension mortgage debentures, Nos. 397 to 446 of £500 to 1,501A to 1,570A of £100 each.

Companhia Ferro Carril do Jardim Botanico (Jardim Botanico Tramway Co.)—£800,000 5 per cent. forty-year first mortgage bonds of £100 each, Nos. A1 to 8,000.

Westminster Electric Supply Corporation, Ltd.—Further issue of 20,578 4½ per cent. cumulative preference shares of £5 each fully paid, Nos. 191,280 to 211,962.

Fraser & Chalmers, Ltd. — The directors report that the profit for the year ended June 30th, 1911, is £31,892, which shows an improvement over the year ended June, 1910. The volume of business has been large, but the margin of profit in all branches has been very close, so that the percentage on turnover is small. The manufacture of large gas engines has been taken up as an additional line of work for Erith, the design adopted representing improvements upon a well-established type. It was considered necessary to enter upon this business in addition to turbines, in order to keep up with the tendencies of the highest engineering in the matter of future power production. Very successful work has been done during the year in the building of turbo-blowers and ventilating fans. Highly satisfactory results have been obtained by the new Bettington boilers for the use of pulverised fuel, and they are showing great economy in operation. After paying the full preference dividend of 7½ per cent., the directors recommend a final dividend of 3½ per cent. on the ordinary shares, making 7 per cent. for the year, and £84,132 is to be carried forward.

Barcelona Traction, Light and Power Co.—A Frankfort message to the *Financial News* quotes a Paris report to the effect that the well-known Canadian group who control the Rio de Janeiro Tramway, Light and Power Co., Ltd., have acquired, in Barcelona, two big water-chutes, and propose to erect two large electrical stations, of 120,000 H.P. The group, it is added, has already obtained a concession to complete a tramway line in the centre of Barcelona. A new company has been created, called the Barcelona Traction, Light and Power Co., and a capital of £4,000,000, it is added, has already been provided.

Venezuela Telephone and Electrical Appliances Co., Ltd.—The directors report that the accounts for the year to June 30th, after providing for interest on debentures and loans, show a net profit of £550, increasing the credit balance brought forward to £5,855.

Mackay Companies.—The regular quarterly dividends of 1 per cent. on the preferred shares and 1¼ per cent. on the common shares are announced.

Canadian General Electric Co.—A quarterly dividend of 1¾ per cent. on the common stock is announced.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.		No. of wks.	Total to date.		Route miles open.	
		£	£*		£	£*		Inc.
Aberdeen	Nov. 22	2,711	+ 240	25	38,869	+ 2,192	..	..
Ayr	„ 25	366	+ 19	23	11,044	+ 60	8	..
†Bath	„ 15	678	+ 25	46	38,896	+ 1,156	..	..
Birkenhead	„ 24	2,049	+ 70	34	59,478	+ 1,417	13·7	..
Birmingham Corp.	„ 18	18,822	+5,098	33	279,976	+53,778	56·4	..
Blackburn	„ 22	2,108	+ 218	34½	49,803	+ 3,475	14·6	..
Blackpool Corp.	„ 23	794	+ 86	..	56,077	+ 7,226	..	..
Blackpool-Fleetw'd	„ 25	481	+ 67	21	24,540	+ 2,028	..	..
Bolton	„ 26	4,890	+ 341	35	88,164	+ 5,868	26	..
Bournemouth	„ 22	2,852	+ 269	34	63,987	— 461	21·95	..
Bradford	„ 18	10,070	+ 512	33	185,249	+12,776	56	1·2
Brighton	„ 26	1,545	+ 138	34½	37,918	+ 2,266	9·5	..
Bristol	„ 24	11,490	+ 743	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	„ 17	502	+ 76	46	10,362	+ 302	3·65	..
Barnsley	„ 17	373	+ 41	„	8,554	+ 233	..	..
Barrow	„ 17	595	+ 147	„	14,291	+ 2,006	5·37	..
Devonport	„ 17	959	+ 171	„	23,055	+ 3,429	8·85	..
Gateshead	„ 17	2,094	+ 144	„	48,150	+ 2,627	11·25	..
Gravesend	„ 17	407	+ 46	„	9,898	+ 868	6·5	..
Greenock	„ 17	1,367	+ 445	„	33,588	+ 5,038	7·25	..
Hartlepool	„ 17	490	+ 115	„	12,644	+ 1,235	6·72	..
Kidderminster	„ 17	185	+ 17	„	5,439	+ 309	..	..
‡Leamington	„ 17	288	+ 2	„	8,255	+ 391	..	..
Merthyr	„ 17	410	+ 31	„	9,670	+ 155	2·9	..
Metropolitan	„ 17	16,786	+2,970	„	405,426	+60,999	22	..
Middleton	„ 17	791	+ 48	„	15,795	+ 1,250	8·5	..
Mid. Joint Com'tee	„ 17	8,512	—2,932	„	242,979	—24,096	..	..
Oldham—Ashton	„ 17	1,144	+ 101	„	26,515	+ 1,068	9·13	..
Peterborough	„ 17	222	+ 19	„	5,975	+ 603	5·31	..
Potteries	„ 17	4,240	+ 396	„	90,513	+ 8,356	29	..
Rothesay	„ 17	75	..	„	9,957	+ 57	2·75	..
Southport	„ 17	482	+ 23	„	14,133	+ 548	8·17	..
S. Metropolitan	„ 17	1,481	+ 146	„	40,072	+ 2,085	..	..
Swansea	„ 17	2,142	+ 114	„	52,488	+ 3,054	12·5	..
Tynemouth	„ 17	393	— 2	„	12,281	+ 385	3·75	..
Weston-s-Mare	„ 17	68	+ 7	„	8,088	+ 1,050	3	..
‡Worcester	„ 17	521	+ 49	„	13,798	+ 690	5·75	..
Wrexham	„ 17	204	+ 32	„	4,726	+ 256	..	..
Yorks. Wool. Dist.	„ 17	2,024	+ 191	„	48,783	+ 3,255	17	..
Miscellaneous	„ 17	409	+ 82	„	10,517	+ 672	..	..
Burnley	„ 25	2,628	+ 301	..	..	..	11·7	..
Burton-on-Trent	„ 26	498	+ 26	34	10,048	+ 615	6·6	..
Bury	„ 26	2,418	+ 326	34½	44,813	+ 3,886	22·5	..
Cardiff	„ 25	4,401	+ 473	34	86,054	+ 6,766	..	..
Chatham and Dist.	„ 23	1,508	+ 91	47	40,292	+ 61	15	..
Cork	„ 23	880	+ 16	47	23,565	+ 561	9·9	..
Croydon	„ 17	3,266	+ 357	33	61,066	+ 4,441	11·4	..
Darlington	„ 24	448	+ 56	35	7,788	+ 746	..	..
Darwen	„ 18	509	+ 31	34	9,270	+ 707	4·86	..
Dover	„ 24	409	+ 48	33	9,107	+ 1,331	4·75	..
Dublin	„ 24	10,186	+ 408	..	131,625	+11,859	54·5	..
Dundee	„ 22	2,212	+ 57	27	52,513	— 760	15	..
East Ham	„ 25	2,044	+ 207	34	37,316	+ 1,957	7·8	1
Exeter	„ 24	545	+ 30	34	12,169	+ 863	5·5	..
Glasgow	„ 25	37,339	+3,780	..	489,246	+34,690	98	..
Hastings	„ 23	1,424	+ 114	..	..	..	..	..
Huddersfield	„ 22	3,669	+ 219	34	66,084	+ 6,974	29·5	1
Hull	„ 25	5,870	+ 559	34	99,594	+ 5,402	14·25	..
Ilkeston	„ 23	242	+ 7	34	4,572	+ 92	..	..
Ipswich	„ 25	674	+ 52	34	15,923	+ 911	10·5	..
Kilmarnock	„ 25	245	+ 19	28	4,195	+ 376	4·25	..
Lancashire United	„ 22	2,469	+ 183	47	63,579	+ 2,257	39	..
Leeds	„ 18	14,527	+1,376	33	292,879	+17,544	50·71	2
Leicester	„ 25	4,870	+ 491	..	..	..	..	..
Leith	„ 25	1,190	+ 130	27½	18,669	+ 1,825	8·7	..
Liverpool	„ 18	22,883	+1,359	46	527,708	+16,780	116	2·5
†L.C.C.	„ 15	86,463	+6,723	..	1,456,247	+72,367	140	6
London United	„ 25	10,612	+ 955	..	207,041	+10,860	..	..
Lowestoft	„ 25	328	+ 20	8	1,468	+ 41	3·5	..
Manchester	„ 25	31,636	+3,570	34	558,246	+30,461	188	..
Newcastle	„ 25	8,264	+ 995	..	146,395	+10,678	14·5	..
Newport	„ 25	1,502	+ 68	34	24,462	+ 964	14·5	..
Oldham	„ 26	3,787	+ 222	35	68,415	+ 3,108	23·75	·5
Pontypridd	„ 25	815	+ 58	34	14,324	+ 14	5·5	..
Portsmouth	„ 25	3,264	+ 276	34	80,079	+ 6,592	15	..
Preston	„ 22	1,419	+ 54	34	27,054	+ 2,002	..	..
Rotherham	„ 23	1,342	+ 111	33½	23,440	+ 1,918	12	..
Salford	„ 20	9,322	+ 495	33	164,503	+ 7,265	..	..
Sheffield	„ 28	12,769	+ 966	..	225,964	+14,541	40	..
Southampton	„ 22	2,173	+ 318	34	43,191	+ 5,894	22	..
Southend-on-Sea	„ 22	920	+ 185	34	25,511	+ 3,869	..	..
†South Shields	„ 18	570	+ 89	33	21,231	+ 2,218	..	..
Swindon	„ 22	294	+ 33	..	5,551	+ 615	..	..
Tyneside	„ 22	845	+ 192	21	10,925	+ 1,614	..	..
Wallasey	„ 11	1,960	+ 168	22	36,866	+ 5,276	..	..
Walthamstow	„ 25	1,243	+ 110	34	26,100	+ 1,711	9	..
West Ham	„ 16	5,299	+ 627	33	90,781	+ 8,198	15·25	..
Wolverhampton	„ 22	1,824	+ 90	34	33,900	+ 2,017	25	..
Cen. London Rly.	„ 25	10,484	— 740	21	98,885	—15,585	6·22	..
City & S. Lon. Rly.	„ 26	6,633	— 188	21	66,149	— 188	7·26	..
Dublin-Lucan Rly.	„ 21	214	..	21	3,240	— 51	7	..
G.N. and City Rly.	„ 25	3,239	+ 178	21	29,847	+ 669	3·5	..
L'pool Overh'd Rly.	„ 26	2,825	+ 186	..	31,641	+ 1,801	6·8	4·2
Llandudno-Col. Bay	„ 24	253	+ 24	51½	15,256	+ 607	..	..
London Elec. Ry. Co.	„ 25	28,975	+1,405	21	267,385	+ 9,025	21·25	..
Mersey Railway	„ 15	4,274	+ 164	21	40,487	— 1,214	4·5	..
Metropolitan Rly.	„ 26	85,597	+ 976	21	848,784	— 4,890	24·5	..
Met. District Rly.	„ 25	24,208	+1,028	21	233,559	+10,619	24	..
Anglo-Argentine	„ 25	108,923	+6,211	..	2,800,097	+198,166	..	..
‡Auckland	Oct.	16,485	+1,412	..	64,857	+ 5,028	23·3	·6
Bombay (B.E.T.)	Oct. 27	6,748	+1,047	43	124,377	+ 8,219	..	..
‡Brisbane	Oct.	21,820	+2,120	40	205,980	+24,290	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Nov. 25	7,965	+ 895	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
‡Kalgoorlie, W.A.	Oct.	3,251	..	..	34,779	..	20·5	..
‡Lisbon	..	..	..	..	..	..	..	..
Madras	Nov. 15	1,421	+ 118	..	31,067	+ 2,688	..	..
‡Montevideo	Oct.	25,084	+2 022	52	298,558	+18,568	..	..
Perth (W.A.)	Nov. 24	3,818	+ 423	..	75,869	+16,444	29	..

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. ‖ One month.

STOCKS AND SHARES.

Tuesday Evening.

THE tightening of money rates in advance of the usual end-of-the-year requirements did not catch the Stock Exchange by surprise, and quotations have been little affected by the stiffness in Lombard Street. The Stock Exchange hung with keen expectation upon the speech made by Sir Edward Grey in the House of Commons last night. On the whole, it was received with a good deal of favour, but the improvement started in markets in the anticipation of it proving pacific became lost later on in most of the Home markets, rumours being current of fresh political troubles in connection with the Dardanelles.

Railwaymen took a holiday from violence in their speechmaking on Sunday last, much to the relief of the market in the Stock Exchange. The pendulum swung upwards again, and chief amongst the stocks to harden was London Brighton Deferred, in expectation of a good dividend next month. The Tube Railway stocks are not much changed. Metropolitan eased off ¼, but Districts remained at 30, while the Central London and City and South London groups have not an alteration between them. District 4 per cent. Debenture stock, however, put on a point.

Electricity Supply shares are steady, but there is no especial feature. The quotation for St. James' Ordinary has been widened in the upward direction. Notting Hill 6 per cent. non-cumulative Preference are this week officially quoted at 10¼ middle.

Home Tramway issues in the electrical market are mainly quiet. British Electric Traction Ordinary fell ⅛ to 1 1/16 after the directors' scheme was confirmed at the second meeting last week. Potteries Preference are 3/32 higher, and the Ordinary shares retained their previous improvement.

Colonial and Foreign Tramways are fairly steady. The principal movement in the group is a rise of 2 secured by British Columbia 4½ per cent. Vancouver Debenture. The Preferred and Deferred stocks keep firm. Brisbane Ordinary rose ¼, and the Debenture stock at 104½ is 1 up. The Mexico Tramways bonds are lower in both cases, and Rio Tramway shares again went down on the coming new issue, but recovered their loss. The latter company's bonds are both better, each description rising ¼.

The Latin-Canadian division is steady as a whole, but a few sellers appeared towards the end of the account. The ordinary demand for money has caused a little selling of bonds in this department. Shawinigan 4½ per cent. Debenture is easier. Electrical Development of Ontario Bonds lost half of their recent rise. Monterey Bonds dwindled to the same extent. Mexican Light and Power Common shares receded to 90. The company's newly issued Second Debenture remains firm at ½ discount, and the floating supply is being slowly absorbed. Allotments of the new South American Light and Power appeared towards the end of last week, and selling by the stags brought about a reaction from 3 premium to 2½ premium, dealings being effected for the ordinary fortnightly account, instead of being carried forward to special settlement as is the case with the majority of new issues. Calgary Power First Mortgage Bonds were weakened, although not quotably so, by the offer of the Western Canadian Natural Gas; but as the underwriters of the latter were left with about 75 per cent. of their commitments, it is evident that the public did not take very kindly to the new comer. Cordoba Light and Power Ordinary shares advanced 1/16, and the company's 5 per cent. Debenture stock is worth noticing as a good investment of its class. Northern Light and Power Bonds followed up their rise of 6 with a further increase of a point, the price now standing at 42 middle. Kalgoorlie Electric Ordinary are steady at 5s. 7½d., and the Preference show a slight rise at 14s. 4½d.

Wild excitement prevails over the vivid movements in Marconi shares. The price is now, of course, *ex* rights, and these latter jumped up to 7s., while for special settlement the new shares rose to 7s. 6d. premium. Probably the little dispute which arose in connection with certain patents, the ownership of which is claimed by Marconi's and the Universal Cheap Cables, Ltd., led to bear sales by market operators, who have had to pay handsomely for their temerity.

The Anglo-American Telegraph group is steady to firm, Anglo Deferred being the only exception. Western Telegraphs continue to harden. Eastern Extensions have eased off a shade, and Globe Preference at 13 are ¼ lower.

National Telephone Deferred is a quieter market, the price showing a recovery of 10s. after its drop. No changes have occurred in the quotations of Uruguayan companies' issues, although the proposal of the Government to nationalise all the electrical projects in that country is regarded without much favour by the markets concerned on this side.

Babcock & Wilcox Ordinary have gained 5s., and Crompton Debenture put on 1¼. General Electric Preference shares fell 5s. and the Debenture stock lost a point.

May we repeat here the notice which, for some weeks past, has appeared at the foot of our price lists, viz., that the yields are calculated upon the dividends paid for 1910. It will be manifest that some uniform plan must be followed, for the avoiding of confusion: when the full results for 1911 are available, they will take the place of the 1910 basis at present used.

Sao Paulo Tramway, Light and Power Co., Ltd.—The directors have declared a quarterly dividend at the rate of 10 per cent. per annum.

SHARE LIST OF ELECTRICAL COMPANIES'.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Nov. 28th.	Rise + or Fall —	Present Yield p.c. £ s. d.
	*					
Bournemouth & Poole, Ord.	10	5½	5†	7⅞ — 8⅜	..	6 5 9
Do. 4½ % Pref.	10	4½	4½	8⅝ — 9⅜	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10¾ — 11	..	5 9 1
Do. 4½ % Deb. Stock	Stock	4½	4½	101 —103	..	4 7 5
Brompton & Kensington, Ord.	5	10	9†	7¾ — 8⅜	..	5 19 4
Do. 7 % Cum. Pref.	5	7	7	7¾ — 8	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	100 —103	+1	3 17 8
Charing Cross, West End & City	5	5	5†	3¾ — 4	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4¼ — 4⅝	..	4 12 4
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4¼	..	5 5 11
Do. Do. 4 % Deb.	100	4	4	94 — 98	..	4 1 8
Chelsea, Ord.	5	5	4†	3⅜ — 4⅜	..	5 14 3
Do. 4½ % Deb.	Stock	4½	4½	98 —100	..	4 10 0
City of London, Ord.	10	7	6†	12⅜ — 12⅝	..	5 8 9
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 12 4
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb.	100	4½	4½	101 —104	..	4 6 7
County of Durham, 5 % First Mort. Deb.	Stock	5	5	89½ — 91½	..	5 9 3
County of London, Ord.	10	5	4†	8⅜ — 9⅛	..	4 18 8
Do. 6 % Pref.	10	6	6	11 — 11½	..	5 4 4
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	99 —102	..	4 8 3
Edmundson's, Ord.	5	Nil	Nil	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2 — 2½	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	82 — 85	..	5 5 11
Folkestone	5	6	6†	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4⅝ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	95 — 98	..	4 11 10
Hove	5	9	8†	6⅞ — 7½	..	6 4 2
Kensington & Knightsbridge, Ord	5	9	8†	6⅞ — 7½	..	6 4 2
Do. 4 % Deb.	Stock	4	4	91 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	3	2	..	1⅛ — 2	..	3 0 0
Do. 6 % Pref.	5	6	6	4⅛ — 4⅞	..	6 3 1
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92	..	4 7 0
Metropolitan	5	5	4†	3½ — 4	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4⅜	..	4 14 9
Do. 4½ % First Mort. Deb.	Stock	4½	4½	101 —106	..	4 4 11
Do. 3½ % Mort. Deb.	Stock	3½	3½	84½ — 87½	..	4 0 0
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96⅛ — 98⅛	..	4 11 5
Newcastle-on-Tyne	5	4	4†	3¾ — 4	..	5 0 0
Do. 5 % Pref., Non-Cum.	5	5	5	4 — 4½	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99 —102	..	4 18 0
Notting Hill, 6 % Non-Cum. Pref.	10	..	..	10 — 10½	..	..
Oxford	5	7½	6†	6⅛ — 6⅜	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10†	8 — 9	+ ½	5 11 1
Do. 7 % Pref.	5	7	7	6¾ — 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	86 — 88	..	3 19 7
Smithfield Markets, Ord.	5	Nil	..	1⅜ — 1⅝	..	Nil
South London, Ord.	4	5	..	2⅜ — 3¼	..	6 3 1
Do. 5 % First Mort. Deb.	100	5	5	99 —102	..	4 18 0
South Metropolitan, 7 % Pref.	1	7	7	1 — 1⅛	..	6 3 11
Do. 4½ % First Deb. Stock	100	4½	4½	95 — 98	..	4 11 10
Urban, Ord.	5	5	..	⅜ — ⅝	..	..
Do. 5 % Cum. Pref.	5	5	..	2 — 2½	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	86⅛ — 88⅛	..	5 1 8
Westminster, Ord.	5	10	10†	7⅝ — 8⅛	..	5 19 5
Do. 4½ % Cum. Pref.	5	4½	4½	4⅝ — 5⅛	..	4 3 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 6 8
Calcutta, Ord.	5	8½	7†	6⅜ — 7 xd	..	6 1 5
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	96½ — 98½	..	5 1 6
Canadian Gen. El. Com.	$100	7	7†	115 —120	..	5 16 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	3	..	⅞ — 1	+ 1/16	3 0 0
Do. 5 % Deb.	100	5	..	93 — 96	..	5 4 2
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	94 — 96	..	6 5 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84½ — 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	91 — 93	— ½	5 7 6
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	7/32 — 11/32	+ 1/32	Nil
Do. 6 % Pref.	1	6	6	31/32 — 1 1/32	+ 1/32	7 18 10
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	..	4 16 2
Madras, Ord.	5	..	..	2⅝ — 3⅛	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	98 —100	+1	5 0 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	88 — 90	..	5 11 1
Mexican Lt. & Power, Common	$100	4	4†	89 — 91	—1	4 7 11
Do. 7 % Cum. Pref.	$100	7	7	108 —110	..	6 7 3
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95⅓ — 97⅓	..	5 2 7
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	90½ — 92½	— ½	5 8 1
Montreal, Lt., H. and Power	$100	7	8	185 —190	..	3 13 8
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	41 — 43	+1	11 12 6
River Plate, Ord.	Stock	10	..	228 —233	..	4 5 10
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —113	+1	5 6 2
Do. 5 % Deb. Stock	Do.	5	5	102 —104	..	4 16 3
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital	$100	4	5†	122 —124	..	3 3 8
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	102½—104½ xd	— ½	4 6 2
Toronto Power, 4½ % Deb.	Do.	4½	4½	100 —102	..	4 8 3
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	..	5 6 5
Victoria Falls Power, Pref.	1	Nil	11¼d.	13/16 — 15/16	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	106½—108½	..	5 10 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	..	7⅛ — 7⅜	..	..
Do. 5 % Deb. Red.	Stock	5	5	99 —101	..	4 19 0
American Telep. & Teleg., Cap.	$100	8	8†	144 —146	+1	5 9 7
Do. Collat. Trust	$1000	4	4	95 — 97	+ ½	4 2 6
Anglo-American Telegraph	Stock	3¾	3†	66 — 68	—1	5 8 8
Do. 6 % Pref.	Do.	6	6	110½—111½	..	5 10 4
Do. Def.	Do.	30/-	..	25⅛ — 26⅛	— 1/8	5 14 3
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	7	..	6⅞ — 7⅛	..	4 18 8
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	86½ — 88½	— ½	4 10 5
Cuba Telegraph	10	6	6†	10 — 10⅜	..	5 11 7
Do. 10 % Pref.	10	10	10	17 — 18	..	5 11 1
Direct Spanish Telegraph, Ord.	5	4	4†	3½ — 3¾	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	8½ — 8¾	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	100 —102	..	4 8 3
Direct United States Cable	10	4½	..	7⅞ — 8⅛	..	5 9 1
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99½—101½	..	4 8 8
Eastern Telegraph, Ord. Stock	Stock	7	5†	137 —140	..	5 0 0
Do. 8½ % Pref. Stock	Do.	8½	8½	83½ — 85½	..	4 1 10
Do. 4 % Mort. Deb.	Do.	4	4	100½—102½	..	3 18 1
Eastern Extension	10	7	5†	13⅜ — 13⅝	— ⅛	5 2 9
Do. 4 % Deb.	Stock	4	4	100½—102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	98½—100½	..	3 19 7
Globe Telegraph and Trust	10	5⅞	6	10⅞ — 11⅛	..	5 6 8
Do. 6 % Pref.	10	6	6	12⅞ — 13⅛	— ⅛	4 10 9
Great Northern Telegraph	10	18	5†	87½ — 89½	..	5 8 3
Indo-European Telegraph	25	13	5†	56 — 58	..	5 12 1
Mackay Companies Common	$100	5	5†	86 — 89	..	5 12 4
Do. 4 % Cum. Pref.	$100	4	4	74 — 77	..	5 8 11
Marconi's Wireless Telegraph	1	5	..	2⅞ — 2⅝	+ 1/16	..
Do. 7 % Cum. Partic. Pref.	1	16	..	1⅜ — 2⅛	..	..
Monte Video Telephone, Ord.	1	6	6	1⅛ — 1 1/16	..	5 12 11
Do. 5 % Pref.	1	5	5	13/16 — 7/8	..	5 6 8
National Telephone, Pref.	Stock	6	6†	103½—105½	..	5 13 9
Do. Def.	Do.	6	6†	122 —124	+ ½	4 16 9
Do. 6 % Cum. 1st Pref.	10	6	6	9⅞ — 10½	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9¼ — 10⅛	..	5 17 1
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5¼ — 5½	..	4 10 11
Do. 3½ % Deb.	Stock	3½	3½	99 —101	..	3 9 4
Do. 4 % Deb.	Do	4	4	99 —101	..	3 19 3
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100½—101½	..	4 8 8
Oriental Telep. and Elec.	1	8	..	1⅛ — 1⅜	..	4 18 6
Do. 6 % Cum. Pref.	1	6	6	1⅜ — 1 3/16	..	4 18 8
Do. 4 % Red. Deb.	Stock	4	4	88¾ — 90¾	..	4 8 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	100 —102	..	3 18 5
Reuter's	8	5	5†	8¼ — 9¼	— ½	4 6 6
Submarine Cables Trust	Cert.	6	6	180 —183	..	4 10 3
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7¼ — 7½	..	5 6 8
Do. 5 % Cum. Pref.	5	5	5	5¼ — 5½	..	4 10 11
West Coast of America	2½	2½	2½	1 1/16 — 1 1/8	..	4 15 3
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	99 —101	+ ½	3 19 3
West India and Panama Teleg.	10	1½	..	2⅜ — 3	..	4 3 4
Do. 6 % Cum. 1st Pref.	10	6	6	10¼ — 10⅝	..	5 11 7
Do. 6 % Cum. 2nd Pref.	10	6	6	10 — 10½	..	5 14 3
Do. 5 % Debs.	100	5	5	103 —105	+1	4 15 3
Western Telegraph, Ltd.	10	7	6†	13⅜ — 14⅛	+ ⅛	4 18 3
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 17 8
Western Union Tel., 4 % Bnds. A	$1000	4	4	106 —109	+ ½	3 13 5
Do. 4½ % Fdg. Bonds	$1000	4½	4½	99½—102½	+ ½	4 7 19

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Nov. 28th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	* 1	Nil	Nil	1/16 — 1/8	..	Nil
Do. 5 % Pref.	1	5	5	3/4 — 7/8	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11
Brit. Elec. Trac., Ord.	10	Nil	Nil	7/16 — 1/2	— 1/8	Nil
Do. 6 % Pref.	10	1½	1½	3 3/4 — 4 3/8	..	3 8 7
Do. 5 % Deb.	100	5	5	98 — 96	..	5 4 2
Do. 4½ % 2nd Deb.	100	4½	4½	78 — 82	..	5 9 9
Central London Railway, Ord.	100	3	3†	67 — 69	..	4 5 9
Do. Pref.	100	4	4	84 — 86	..	4 13 0
Do. Def.	100	2	..	50 — 52	..	3 18 5
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 11
City & South London, Ord.	100	1½	1½†	30½ — 31½	..	4 14 3
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 —104	..	4 15 3
Do. Do. 1903	100	5	5	102 —104	..	4 16 2
Do. 4 % Deb.	100	4	4	100 —102	..	3 18 5
Dublin United Trams, 6 % Pref.	10	6	6	11 — 12	..	5 0 0
Great Northern & City, Pr'f. Ord	10	Nil	..	1 — 1 1/8	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	3†	1/8 — 3/16	..	Nil
Do. 4½ % Deb.	100	4½	4½	73 — 78	..	5 14 8
Isle of Thanet Trams, 5 % Pref.	5	2½	..	2½ — 3	..	4 3 4
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 82	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	..	2 1/4 — 2 3/8	..	Nil
Do. 4 % Deb.	100	4	4	71 — 75	..	5 6 8
Metropolitan Railway Consol.	* 100	1 3/8	2†	42½ — 43	— 1/4	3 3 11
Do. Surplus Lands	100	2 1/2	3†	65 — 67	..	4 2 1
Do. 3½ % Deb.	100	3½	3½	89 — 91	..	3 17 0
Do. 3½ % Pref.	100	3½	3½	85 — 87	..	4 0 6
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	..	29 3/8 — 30 1/4	..	Nil
Do. 6 % Deb.	100	6	6	144 —146	..	4 2 2
Do. 4 % Deb.	100	4	4	97 — 99	+1	4 0 10
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	3½	4½†	88 — 90	..	3 12 3
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 12 1
Metropolitan Elec. Trams, Ord.	1	5/9	5†	3 7/8 — 3 15/16	..	5 12 4
Do. Def.	1	Nil	..	3/8 — 7/16	..	Nil
Do. 5 % Pref.	1	5	5	3 7/8 — 3 15/16	..	5 3 1
Do. 4½ % Deb.	100	4½	4½	100½—102½	..	4 7 10
Do. 5 % Deb.	100	5	5	100½—102½	..	4 17 7
Potteries, Ord.	1	2	..	1/16 — 1/8	..	
Do. 5 % Pref.	1	5	5	1/16 — 1/8	+1/32	6 13 4
Do. 4½ % Deb.	100	4½	4½	87½ — 90½ xd	..	4 17 2
South Metro. Trams, 6 % Pref.	1	6	..	5/8 — 3/4	..	6 17 2
Do. 4 % Deb.	100	4	4	72 — 77	..	5 3 11
Underground Elec. Railways	10	..	..	1 7/8 — 2 1/8	..	
Do. 4½ % Bonds	100	4½	4½	100 —102	..	4 8 3
Do. 6 % Income	100	1	1½†	63 — 65	..	1 10 9
Do. Power House Debs.	100	4	4	100 —102	..	3 18 5
Yorkshire (West Riding), Ord.	5	Nil	..	1/16 — 3/32	..	Nil
Do. 6 % Pref.	5	Nil	..	2 3/8 — 2 1/2	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½†	4 15/16 — 5 3/16	..	4 16 5
Do. 2nd Pref.	5	5	5½†	4 7/8 — 5	..	5 0 0
Do. 4 % Deb.	100	4	4	94 — 96	+ 1/2	4 8 4
Do. 4½ % Deb.	100	4½	4½	101½—103½	— 1/2	4 7 0
Do. 5 % Deb.	100	5	5	100½—102½	..	4 18 0
Auckland Trams, 5 % Deb.	100	5	5	104 —107	..	4 13 6
Bombay Elec. S. & Trams, Pref.	10	6	6	10 3/8 — 11 1/4	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	97 — 99	..	4 10 11
Do. 5 % 2nd Deb.	100	5	5	98½—100½	..	4 19 6
Brisbane Trams Invt., Ord.	5	8	8†	7 3/4 — 8 1/4	+ 1/4	4 17 0
Do. 5 % Pref.	5	5	5	4 3/8 — 5 1/4	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	103 —106	+1	4 5 9
B. Columbia Elec. Rly., Def.	100	8	..	143 —147	..	5 8 10
Do. Pref. Ord.	100	6	6	124 —128	..	4 13 9
Do. 5 % Pref.	100	5	5	109½—112½	..	4 8 11
Do. 4½ % 1st Mort. Deb.	40	4½	4½	99 —102	..	4 8 3
Do. 4½ % Vancouver Deb.	100	4½	4½	104 —106	+2	4 4 11
Do. 4½ % Con. Deb.	100	4½	4½	102 —104	..	4 6 7
Calcutta Trams, Ord.	5	6	..	5 3/8 — 6 1/8	..	4 18 2
Do. 5 % Pref.	5	5	5	5 — 5 1/4	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	2½†	1/16 — 3/32	..	4 0 0
City Buenos Aires Trams (1904)	5	5	5	5 3/8 — 5 1/2 xd	..	4 5 1
Do. 4 % Deb.	100	5	5	97 —100	..	5 0 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	101½—104½	..	4 15 8
Kalgoorlie Elec. Trams	1	Nil	..	1/16 — 3/32	..	Nil
Do. 5 % A Deb.	100	5	5	92½ — 95½	..	5 4 9
Do. 6 % B Deb.	100	5	6†	82 — 86	..	7 11 6
La Plata Elec. Trms, Prf.	1	6	6	3/8 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6†	1 — 1 1/4	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1 1/4	..	4 16 0
Do. 5 % Deb.	100	5	5	96 —100	..	5 0 0
Madras Elec. Tr. (1904), Deb.	100	5	5	96 — 99	..	5 1 0
Manaos Trams & Lt., 1st Deb.	100	5	5	92 — 94	..	5 6 5
Manila Elec. R. and Lig., Bonds	$1000	5	5	99 —101	..	4 19 0
Mexico Trams Com.	$100	7	7†	123 —125	..	5 12 0
Do. Gen. Con. 5 % Bonds	..	5	5	98 —100	— 1/2	5 0 0
Do. 6 % Bonds	100	6	6	102 —104	—1	5 15 3
Para Elec. Rlys. & Lt., Ord.	5	10	10†	6 7/8 — 7 1/8	..	6 18 0
Do. 6 % Pref.	5	6	6	5 3/4 — 5 7/8	..	5 4 4
Do. 5 % 1st Deb.	100	5	5	99 3/4—101 1/2	..	4 18 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1 5/16 — 1 7/16	..	2 7 1
Do. 5 % 1st. Deb.	100	5	5	101½—103½	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 1/4 — 5 1/2	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	..	4 9 1
Rio de Janeiro Trams	$100	4½	5†	115 —116	..	4 6 2
Do. 1st Mort. 5 % Bonds	..	5	5	102 —103	+ 1/4	4 17 1
Do. 5 % Mort. Bonds	100	5	5	95 3/4 — 96 1/4	+ 1/4	5 3 4
Sao Paulo Tram, Lt. and P.	$100	10	10†	185 —189	..	5 5 10
Do. 5 % 1st Deb.	$500	5	5	104½—106½	..	4 13 11
Singapore Trams, 5 % Deb.	100	5	5	82 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 3/4 — 97 1/4	..	5 2 7
Un. Elec. Trams Monte Video	5	6	7	5 1/2 — 6	..	5 0 0
Do. 6 % Pref.	5	6	6	5 — 5 1/4	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	104 —106	..	4 4 11

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	3/8 — 3/4	..	Nil
Do. 6 % Pref.	1	9	6	3/8 — 3/4	..	7 2 2
Babcock & Wilcox	1	26	24†	6 — 6 1/4	+ 1/4	4 3 1
Do. Pref.	1	6	6	1 3/8 — 1 1/2	..	4 0 0
B.I. & Helsby Cables	5	10	8†	6 1/4 — 7 1/4	..	6 17 11
Do. Pref.	5	6	6	5 1/4 — 6 1/4	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 97	..	4 12 9
British Westinghouse, Pref.	3	Nil	..	1/4 — 3/8	..	Nil
Do. Deb.	100	4	4	57 — 60	..	6 13 4
Do. 6 % Prior Lien	100	6	6	100 —102	..	5 17 8
Browett, Lindley, Ord.	1	Nil	..	1/6—2/-	..	Nil
Do. Pref.	1	Nil	..	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	..	0 — 1/4	..	Nil
Do. 7 % Pref.	2	Nil	..	0 — 1/4	..	Nil
Do. 4½ % Deb.	100	4½	4½	56 — 61	..	7 7 7
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	10†	9 — 9 3/4	..	7 13 10
Do. Pref.	5	5	5	5 — 5 1/4	..	4 15 3
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
Castner-Kellner	1	17½	20	3 1/16 — 3 1/8	..	5 5 3
Do. Deb.	100	4½	4½	104 —108	..	4 3 4
Crompton & Co.	3	Nil	Nil	1/8 — 3/8	..	Nil
Do. Deb.	100	5	5	60 — 70	+1½	7 2 10
Dick, Kerr	1	5	..	3/4 — 7/8	..	5 14 3
Do. Pref.	1	6	6	1 1/8 — 1 1/8	..	5 12 11
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	..	3/8 — 1/2	..	Nil
Do. fully paid	5	Nil	..	1 1/8 — 2 1/8	..	Nil
Do. 4 % Deb.	100	4	4	69 — 73	..	5 9 7
Do. 5 % Second Deb.	100	5	5	77 — 80	..	6 5 0
Electric Construction	2	Nil	2½†	1/4 — 3/8	..	6 13 4
Do. Pref.	2	7	7	1 3/4 — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7 3/4 — 8 1/4	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8 3/4 — 9 1/2	— 1/4	5 5 8
Do. Deb.	100	4	4	85 — 90	—1	4 8 11
Henley's, Ord.	5	15	10†	11 3/4 — 12 3/4	..	5 18 10
Do. Pref.	5	4 3/4	4 3/4	4 1/2 — 5 1/8	..	4 5 11
Do. Deb.	100	4½	4½	106 —108	— 1/2	4 3 4
India-Rubber, G. & T.	10	10	..	12½ — 14½	..	6 17 11
Do. Pref.	10	5	5	9 1/4 — 10 1/4	..	4 16 5
Telegraph Construction	12	20	10†	35 — 37	..	6 7 5
Do. Deb.	100	4	4	100 —102	..	3 18 5
Willans & Robinson	1	Nil	..	1/16 — 1/8	..	Nil
Do. Pref.	5	Nil	..	1/4 — 3/8	..	Nil
Do. Deb.	100	4	4	55 — 65	..	6 3

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

The yields are calculated upon the dividends paid for 1910.

Bank rate of Discount 4 per cent., September 21st, 1911.

PROCEEDINGS OF INSTITUTIONS.

Graphite as a Lubricant.

ON November 11th a special meeting of the FARADAY SOCIETY was called to meet DR. ACHESON, who has been spending a few weeks in Europe, and to hear him relate the fascinating story of his discoveries of the wonderful products he has succeeded in producing by means of the electric furnace. As the chairman, MR. J. SWINBURNE (Past-President), aptly remarked, Dr. Acheson belongs to that small body of inventors who are really entitled to be called "great," and for this reason: his discoveries have been the result not of chance intuition or of wild guessing, but of steadfastly following up step by step a continuous train of experimental researches, each of which, although perfected in itself, has proved the starting point for a new line of investigation again ending in the appearance of a new product even more wonderful and useful than its predecessor. The members of the Faraday Society, it was pointed out by MR. ROBERT MOND, had special reason to be grateful to Dr. Acheson, for without Acheson graphite it is probable that not a single electrolytic process now flourishing as an industry would ever have emerged beyond the laboratory stage.

Dr. Acheson's electric furnace work dates back 20 years to 1891. In March of that year he made his first carborundum experiment, by mixing clay and coke, putting the mixture in an iron bowl and passing a powerful current by means of a carbon electrode. The small bright speck that appeared on the point of the carbon, and that was so hard that it would easily cut glass, was the first piece of carborundum (carbide of silicon) ever made—or at least, ever recognised as such. A small brick furnace was quickly built and the product made on a somewhat large scale, but wonderful as were its properties—it was eventually proved to be actually harder than diamond, though not so tough—nobody could at first be found to put it to practical use, excepting a few engineers for grinding valves. The emery wheel makers pronounced it useless. It is worthy of note that pure carborundum is not purple-black in colour at all (this is due to the presence of iron), but is perfectly colourless and transparent, with a refractive index greater than that of diamond.

It was soon noticed that carborundum is only produced in the core of the furnace, where the temperature is vastly higher than the walls of the furnace could stand, were they not protected by the material between them and the core. If the core was overheated the carborundum crystals were destroyed, the silicon being driven off and true graphite remaining behind. *Acheson graphite*—this was the inventor's second great find; 13,000,000 lb. of this material were sold last year, and on it depends the future of almost every electro-metallurgical process that has any hopes of industrial survival.

Dr. Acheson's next step was to try and cheapen his process, and he, therefore, looked round for a cheaper form of carbon than the coke he had hitherto employed. He eventually—in 1906—used a waste ash product from the Californian coalfields. When all the foreign material in this was evaporated, a non-coalescent, easily pulverised and exceedingly light form of graphite, remained behind in the furnace.

An incidental development of about the same period was the reduction of silicon, now made in thousands of tons. The difficulty is to make up a charge that will conduct the current, but this was overcome by using the soft Acheson graphite as a reducing agent, and grinding it down with fine amorphous silica. The silica particles are completely encased by the soft graphite and the mixture rendered conductive. The graphite has also been used for the reduction of aluminium from bauxite.

But the most striking application of this form of graphite has been in the production of the wonderful lubricators known as "aquadag" and "oildag." These merely consist of the graphite transformed to a colloidal or "deflocculated" form, and held in suspension in water and oil respectively. The transformation of the graphite is brought about by treatment with gallo-tannic acid and a little ammonia. The action reduces the graphite particles to $\frac{1}{10000}$th of their linear dimensions, and renders them perfectly suspensive, so that they will pass through filter paper. Many other organic agents, such as extract of straw, glass, tea leaves, and even dung, will act in the same way, although the *rationale* of the process is not understood. It is certain that the agent becomes fixed to the graphite, and it probably penetrates its particles, throwing off groups of molecules, or even molecules themselves, each of which is surrounded by the organic jelly.

Many applications of deflocculated graphite have been initiated, such as in electrotyping and the manufacture of lead pencils. But the most important application at present is as a substitute for ordinary oil lubrication. Apart from the fact of the objectionably high viscosity of oil, on account of which some 50 per cent. of the power generated in the world is at present wasted in the lubricant in overcoming friction, the present demand for natural petroleum is so enormous (in 1908 it was 290,000,000 barrels of 42 gallons each), that only a 50 years' limit has been assigned to the present suppliers. "Aquadag," which is colloidal graphite made up with water (about 1 cb. in. to 3 gallons), and "oildag," in which the medium is oil—usually kerosene—form ideal lubricators, as their viscosity is extremely low. In the fine colloidal state the graphite cannot be squeezed out from between the bearing surfaces, but it enters the pores and "evens up" the metals, so that eventually a glass-like surface covered with a veneer of molecular graphite, is produced. Strange to say, steel will not rust in "aquadag." Prolonged experiments have been made in America with these lubricants, and they are at present in use, giving entire satisfaction, in all the transport power houses in New York.

Another most interesting application of deflocculated graphite was mentioned by Mr. Albert Hioeth, of Norway, in the course of the discussion, namely, for guns and rifles, where it not only diminished friction but prevented leakage of the powder gases and stopped the usual discharge of powder in front of the bullet. Where it was not used, the barrels eventually burnt out, so that its use not only enormously enhanced the life of the guns, but increased the range by some 15 per cent. Dr. Acheson stated that its use in the United States for gun lubrication was very extended. Only about four grains of graphite were required for each bullet, and its use almost entirely did away with any wear of the rifle barrel.

The hope was expressed that Dr. Acheson would erect works in Europe for the manufacture of graphite, which was at present expensive over here. The present consumption, however, did not admit of an economical sub-division of its production, although it might not be long before this could be done. In the meantime, he anticipated considerable reduction in price in the near future.

The Mechanical Design of Direct-Current Turbo-Generators.

By R. J. ROBERTS, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *at Manchester, November 7th*, 1911.)

THE most common defects of D.C. turbo-generators are found in the collecting gear, and take the form of sparking, which may arise from unsuitable brush gear or collectors, want of balance generally, or unstable construction of the commutator.

Another common defect is found in the insulation. It is noticed that all high-speed machines, especially with forced ventilation, rapidly accumulate dirt or soot; and frequently it accumulates where it is impossible to clean, either by blowing or brushing.

The bands are another frequent source of trouble; the bands over the armature end windings sometimes break, which, of course, means a wrecked machine.

The design and construction of the stator or field magnet is one of the simplest details of this class of machine. The windings should be arranged so that the cooling air may have ready access to all conductors, and yet leave no pockets for hot air. All conductors must be clamped so as not to leave more than a 10-in. length unsupported.

The radial ventilating ducts in the rotor core must not be placed directly opposite similar duct in the pole-faces, as whistling or shrieking is the inevitable result. The aim of the mechanical designer should be to get the greatest quantity of air through that part producing greatest loss, with the expenditure of least power.

It is now usual to find dust screens fitted in the air ducts to turbo-generators. These are perhaps the simplest and cheapest remedy we have for keeping the machine clean. To cool large transformers, it is usual to pass the transformer oil through a cooling system of water pipes. It appears practicable to pass the cooling air of a generator through a similar system, which might conveniently be placed under the generator, and so use the same air over and over again without its being contaminated with external air. This scheme would generally be more expensive, though less troublesome, than a dust screen, but is particularly adaptable for a separately driven fan.

The quantity of air generally used for cooling purposes is 80 to 100 cb. ft. per minute per kilowatt loss. The power required for fans and air friction is generally a large proportion of the total loss, ranging from 4 per cent. at 100 KW. output to 2·4 per cent. at 750 KW. 1 KW. per 100 cb. ft. of dry air per minute will raise the temperature of air 30° F.

By doing away with radial ventilating ducts in the rotor, and merely using axial ducts, a reduction in fan loss of 1 to 1½ per cent. might be effected. A still greater reduction might be obtained by discarding inefficient fans on the rotor and using a more efficient separately driven fan.

It is the author's experience that, excepting where a shaft is continuous, all bearings should be treated as self-aligning. The reason for this is that the running clearance in a forced lubrication bearing is generally so large as to prevent the bearing having any influence upon the critical speed of the shaft. A machine with rigid bearings ran well with a least 10 mils clearance all round the shaft, and a want of truth of circularity of bearing bush of at least 5 mils.

A well-forged axle-steel shaft is generally good enough for this class of machine. The ultimate strength should be from 35 to 40 tons per square inch, and the elastic limit ·25 to 30 tons per square inch. The carbon should be 0·14 per cent., and sulphur and phosphorus less than 0·035 per cent. each. Owing to the tendency of long shafts to warp during turning, it is desirable to anneal them carefully before the finishing cuts and grinding are attempted.

The art of balancing can only be learnt and not taught. The essential attribute of a balancer is patience, without which he will be tempted to rush his machine through the critical speed before the quality of balance warrants it. Excessive vibration may not only damage the shaft, but it may also damage other parts of the rotor, notably the supports of the commutator.

For the purpose of balancing, the author prefers very rigidly fixed bearings with ample clearances round the shaft to any form of spring controlled or sliding bearings.

The rotor core should be so fixed to the shaft that it cannot become loose. Shrinking the plates on the shaft may increase the core losses, and stampings cannot satisfactorily be pressed on. However, this may be overcome by suitably designing the shaft and core so that the diametrical strains of shaft and core are equal.

Difficulty in reducing the reactance voltage per segment of commutator has resulted in the adoption of open slots, the armature conductors being retained in place by means of wedges driven into recesses in the teeth. To reduce the depth of wedge it is customary to half close the slots and thus reduce the span of the wedges. With two bars per slot, each bar is usually divided into three separate ones in parallel, which enables the bars to be put into slots with narrow openings. The middle bar is dropped in last between the other two. With four bars per slot the opening is often placed to one side, so that the bars can be dropped in one by one, and yet leave the slot opening about one-half the slot width (see fig. 1).

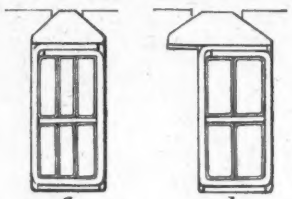


Fig. 1.

The rotor end connections are usually of the ordinary diamond or barrel type tightly packed together on top of the winding drums. Each separate conductor must be well taped and insulated from its neighbour, and a substantial band of insulation must be put between the top and bottom layers. Some prefer micanite, which, when soft, can be moulded to a certain extent. Others use a combination of leatheroid and micanite, the leatheroid being in overlapping segments and giving the necessary mechanical strength whilst the micanite gives the dielectric strength.

At the back end of the armature, the winding can be finished off and leave no exposed part of the current-carrying system. At the commutator end, however, this is not attainable, and this place is the weakest of all for insulating purposes. Where the conductors leave the support of the winding drum, there is a high-velocity current of air which will deposit dirt rapidly in any corner or eddy. The result to be obtained here is not only a sufficient creepage surface, but the elimination of all corners or ledges where dirt might collect.

Equalisers are absolutely necessary with a field of more than two poles. They must be well insulated, and should not show the bare conductor, upon which dirt may collect. They must be very rigidly

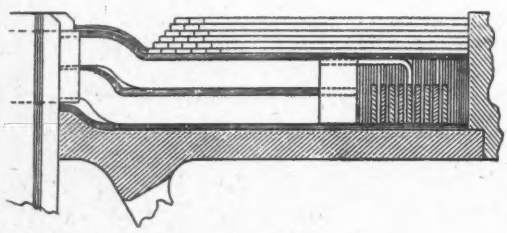


Fig. 2

fixed and supported, lest they should move and so cause unstable balance and harm to the insulation. The best position is at the back end under the band. The equalisers are made of complete rings of copper with projecting tags that are sweated on to the armature conductors. The whole (fig. 2) is first firmly packed up with insulating strips of presspahn or fibre and then banded, which holds everything absolutely rigid and well covered up.

Wire is much preferable to metal rings for the end-winding sheaths. The winding-on of the band in no way disturbs the insulation underneath, and, at the same time, it presses each individual conductor down hard into its place, and so gives less chance of movement. It is not advisable to use round wire for the bands, as it has a smaller space factor than square or rectangular wire.

The majority of the usual defects are traceable to the commutator, and it is of the greatest importance that this should not only be carefully built, but also correctly designed. The segments after proper preparation are assembled in jigs in the usual manner, whilst care is taken that the segments lie parallel to the axis of the cylinder. The insulating segments contain, as a rule, a quantity of superfluous varnish, and this is got rid of by successive bakings and tightening of clamps. The whole, whilst still in clamps, is next turned for the insulating bands under the rings, and banded with temporary bands of steel wire upon that portion of the face where the shrink rings do not come. These bands must not be thick enough to prevent the shrink rings passing freely over them. The insulating bands are next built up in place, banded with fine steel wire and the clamps removed. The shrink rings are then shrunk on, and the whole cylinder is machined where needed and mounted upon the rotor. The advantages of having a non-inflammable surface of fine wire for the ring to shrink on is easily apparent. When an experimental ring was cut it was found that the hot shrink ring had annealed the wire and partially flattened it, and that beyond a distinct marking of the mica there was no sign of any cutting. Further, if the ends of wire were left sticking out beyond the ring it was found impossible to pull any out from under the ring, because the wire sooner broke, where it was held at all.

It is the practice of some manufacturers to leave the insulating bands projecting beyond the rings, whilst others prefer to turn the mica off flush with ring. The latter makes a thoroughly good job; after running some time this mica face becomes coated with dust, but it is easy to clean the surface of the mica by merely wiping it when cleaning the commutator.

A projection of the mica beyond the ring certainly increases the creepage surface. It is not sufficient to leave the mica projecting beyond the ring when shrinking on. The shrink ring should be cut away from the mica, which is then left lying close and compact against the copper face.

It is most important, in choosing the micanite segments, to get them as free from superfluous varnish as is practicable. There has recently been put upon the market a form of micanite that has no varnish in its composition, and, although dearer, is much to be preferred to the ordinary quality. This micanite is stoved at a red heat during its process of manufacture.

In designing a commutator, we must see that there is always sufficient tangential pressure between the copper segments to retain a unit of mica.

The insulating bands under the shrink rings should preferably be built of strips of pure mica of 20 or 30 mils thickness. Sufficient numbers of these are used by even layering to give the required total thickness of band. The use of shellac or other varnish as a binding material is to be deprecated.

The simplest practical commutator is a two-ring, and has a ring at each end of the segments. As the rings are shrunk on, there will be a hoop tension therein, and a corresponding reaction or hoop compression in the segments—fig. 3 (*a*). The compression hoop stress in segments may be resolved into a series of radial forces tending to drive each segment out again—fig. 3 (*b*). Further, it is noticed the compression stress is not necessarily limited to that portion of the segments immediately under the ring, but is distributed along the segments. Hence, as there is a force pushing each segment out again, and as each segment is not absolutely rigid, it will bend, and by that means lower the compression stress at that point of segment proportionally to the amount it deflects. The degree of loading upon each segment pushing it out again will vary, and the maximum load is at the ends where there is no deflection

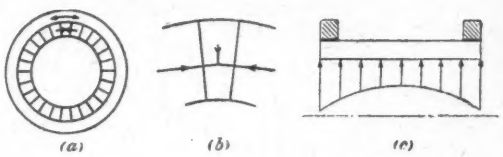


Fig. 3.

and the minimum at the middle, where there will be the greatest deflection—fig. 3 (*c*). By increasing the length of span, ultimately we must reach a particular length such that the reaction in the centre of the span becomes zero.

It is a criterion of good construction in a commutator that there must be no loosening of any part when run up to speed. We must therefore see that the initial deflection given to the bars is always as great as that due to centrifugal forces.

We may conveniently treat all other designs comparatively with that of a two-ring. Thus each end span of a three-ring commutator is equivalent to a simple beam, and a cantilever supporting one end of the simple beam. The middle span of a four-ring commutator consists of a simple beam supported at the ends of two cantilevers.

The theoretical shrinkage allowances may be found by summing up the decrease in diameter of the bars due to the maximum tangential pressure and the increase in diameter of the ring due to the expected initial stress therein. This will be found, as a rule, to give too small a value for the shop to work to, because of the want of circularity of the wire band over the mica, caused by uneven layering of the mica; hence something must be added to the values found to allow for this, as well as for the lack of elasticity of the mica band and segments. The necessary shrinkage allowance, therefore, should be got only from experience.

With some designs of commutators it is not possible to allow sufficient shrinkage allowance on the rings. This difficulty may be overcome by using a hydraulic press to make the rings smaller while still hot and in place on the commutator. Although these presses are reported to be in use on the Continent, the author has not heard of them being used in England.

The supports of the commutator upon the shaft of the generator have been the cause of much trouble. The usual method, which has many slight variations, is to mount it upon two metal cones insulated with micanite, one at each end of the commutator.

The first possible trouble comes from the expansion of the bars themselves, which by several heatings and coolings may ultimately grind the micanite to a powder. Again, some designs are found with the bars not tapered, but left parallel and shrunk upon a uniform sleeve of micanite. This shrinking process is an extremely difficult one to carry out successfully, and if it is not well done, the diametrical expansion of the commutator will make it quite loose upon its supports, possibly sufficient to upset the balance of the

whole machine. Some makers use a spring washer behind one of the tapers to take up the longitudinal expansion, but this may be a danger rather than a remedy unless the tangent of the angle of taper is more than the coefficient of friction between micanite and copper or iron.

Commonly, it is found that the diameter of the shaft under the commutator is smaller than it should be for a perfect shaft, and the difference in slope of the line of deflection of the shaft at the two ends of the commutator is appreciable. This causes a great grinding action on the mica at each revolution of the machine, and is augmented if there is vibration when running through the critical speeds. This is not eliminated by any selection of taper, and the only design the author has heard of that does eliminate this trouble is that of Messrs. Parsons, by which the whole commutator is hung by steel disks from the shrink rings, a construction, however, that calls for great care in design. There are many machines running, nevertheless, where this grinding effect has not been experienced even after years of use. These successes may be attributable to a thoroughly stiff shaft where most needed under the commutator, rendered possible by the use of a high commutator peripheral speed. In general, it may be said that the shaft should be kept fairly uniform in the middle of the span, and should not be reduced to permit a small diameter of commutator.

The commutator risers should be flexible and strong, or else breakages will occur. Of recent years it has become the practice to use a separate fan for the purpose of ventilation; this allows the risers to be made very flexible, and covered by band.

The cooling of commutators on turbo-generators is a great problem, and one that has lately brought forward many solutions. The neatest of these is Messrs. Siemens's design, where the cooling air is brought through the commutator segments themselves by means of axial ducts therein, and drawn through by a fan placed in the middle of the commutator.

The wearing away of the brush upon the commutator face is to be expected, but it is quite common to find that there occurs considerable abrasion of carbon against the holder itself. This is, of course, due to the brush pressing against the holder and the inequality of surface of commutator or even vibration of the holder itself producing the movement. Whatever type of brush-holder is used, experience has shown that the brushes should preferably not be supported on the bearing, because the latter transmits the rotor vibrations which may be greatly amplified in the brush-gear generally.

To look forward to probable improvements of construction, we see that one of the ultimate aims is the decrease in span between bearings. This may lead to a reversion to the Eickemeyer or butterfly winding for the armature, with the equalisers possibly combined in the end connections. The radial type of commutator is possibly the ultimate general design, but it will be some years before this type is generally adopted, and in the meantime we may effect great improvements by the use of higher brush pressures and

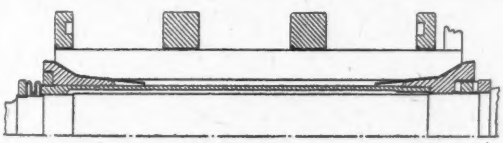


FIG. 4.

higher current densities and peripheral speeds. A suggestion for mounting the commutator is shown in fig. 4. The brush-holders are yet very far from perfect, and possibly the present almost universal box-type holder will disappear for some form of the old lever-type holder.

The present ventilating schemes need much improvement, and an air-cooling system with a separately driven circulating fan is a probable solution.

The author believes that it is possible to make direct-current turbo-generators as reliable as any other electrical machine, and that their mediocre performance in the past has been caused by an inadequate comprehension of the mechanical problems.

DISCUSSION.

MR. R. LIVINGSTONE said that the oil-throwers were often made so that they threw the oil violently from the shaft against the bearing housing, with the result that some of the oil splashed back to the shaft on the wrong side of the thrower, and travelled along the shaft to the armature or commutator. It was much better to rely on oil-glands for retaining the oil in the bearing housing. The efficiency of fans running at peripheral speeds of 12,000 to 18,000 f.p.m. was in the neighbourhood of 10 to 30 per cent., whereas Sirocco fans running at the correct peripheral speeds had efficiencies varying from 45 per cent. to 65 per cent. With separately driven fans the motor efficiency must also be taken into account, but when the fan power exceeded about 5 H.P. a saving was effected. Where such a fan was used, the generator rotor should be made with as little fan action as possible, so as to make it easy to guide the air to where it was required. With air under a pressure of 5 in. water gauge the H.P. of the fan motor would be $\frac{\text{Cb. ft. per min.}}{1{,}200 \times \eta}$ when η was the fan efficiency. Bearings for 3,000-R.P.M. machines having a diameter of 4 to 5 in. would run well if the clearance was 50 to 100 per cent. greater than the amount stated by the author. It was necessary to have a large clearance, to provide for the oil film between the surfaces. One of the chief causes of warping of shafts was the cutting of the keyways, and this was usually done after the shaft was turned. The best practice was to buy shafts rough turned, oil toughened and annealed, and cut as small keyways as were consistent with the torque. A pressure of 8,000 lb. per sq. in. on the laminations was not excessive. Most D.C. machines had to run through the critical speed, and in such cases it was advisable to have the whirling speed two-thirds of the normal speed. It was impossible to design the shaft and core so that the diametrical stresses were equal. The most that could be done was to keep the tangential stress at the inner surface of the core as small as possible. He had designed rotors with a stress of 12,000 lb. per sq. in. in a 3,000-R.P.M. machine, and had not experienced any trouble due to the expanding of the core. It was possible to press a laminated rotor on to the shaft. He liked the slot shown in fig. 1A; fig. 1B was not so good, as the load on the tip of the tooth was eccentric. With good fibre wedges a bending stress of 1,500 lb. per square inch was not excessive, and he had not found the depth of wedge too great even with ordinary open slots $\frac{1}{8}$ to $\frac{1}{16}$ in. in depth, covering all ordinary machines. He most certainly preferred the solid end bell to binding wire. If the windings and bell were made slightly conical, the bell was quite easily put on and taken off. It was advisable to press the windings into their conical shape on a conical support formed by the end plate, so as to give a true hard surface for the end bell. The author was to be congratulated on the clear manner in which he put the theory, and the curves given simplified the working of problems. It was quite correct that the bending of the bars reduced the tangential stresses at the centre of the bar (in a two-ring commutator), and increased it at the ends; in practice however, they must start out, with the assumption that a certain minimum tangential pressure was required on the mica, say 500 lb. per square inch. Then it would be found that the ratio of depth to length of bar did not vary very greatly.

MR. CATTERSON SMITH said that even under good conditions, with commutation poles, one could rarely guarantee the current change in the coil undergoing reversal to be a linear function of time, and thus the ordinary nominal current density was limited to 40 or 45 amperes per sq. in. Any departure from the linear current-change law raised the density over parts of the brush to high values of the order of 200 or 300 amperes per sq. in., and thus it was quite impossible to work with the high densities indicated. With regard to the possibility of cooling the air with a refrigerator, in view of the trouble experienced through the accumulation of dust and dirt brought in by the cooling air in the ordinary system, some such system might well be tried. The commutator risers were one of the most difficult parts to design satisfactorily; he could recall an instance of a turbo-generator which, after 5,000 hours' run, showed 2½ per cent. of the risers fractured and 25 per cent. in a bad condition. He had seen thin steel bands put on the mica bands, and afterwards turned true on the outer surfaces, which were then easily gauged for the shrink rings.

MR. A. R. EVEREST said there could be little doubt as to the desirability of filtering the air supply to D.C. turbo-driven generators. Accumulation of dirt was objectionable not only on account of possible loss of insulation, but also because it interfered with the proper cooling of the parts. In the figure referring to the possible looseness which would occur in a rotor due to the expansion of the punchings from centrifugal force, the possible displacement of the centre of gravity, and the resultant out-of-balance would be one-half that suggested in the paper.

MR. R. HARRISON said he was surprised at the careful attention Mr. Roberts had given to the stresses in the commutator, where the results were so uncertain, because the rings were shrunk on mica. Shrinking the core on the shaft had a tendency to make the shaft stiffen, and therefore to increase the critical speed above the calculated value. Hence it was advisable to made the critical speed above the normal running speed where possible, so that if the core stiffening effect did not raise the critical speed, it was making the machine still safer.

MR. W. HOULT pointed out that as it was extremely important to keep the commutator of the machine cool, and it was better to make the supply of air to the commutator entirely separate from the supply of air that passed through the core, otherwise the air was heated before it got to the commutator. Air filters should be installed wherever the atmosphere contained dirt in suspension. As regarded cooling with a water-jacket or freezing plant, a cheaper and better way for large generators would be to draw the air through fine sprays of water and then through a series of vertical corrugated plates, so as to throw off the water. The water mixing intimately with the air would take away the particles of dust, and also cool it to practically the same temperature. He agreed with other speakers that the use of binding wire for end sheaths was wrong. He agreed with the author that the majority of the usual defects were traceable to the commutator, and that it was of the greatest importance that this should be carefully built and correctly designed.

MR. G. W. WORRALL said the mechanical problem of commutation was twofold. In the first place, the frictional force tends to tilt the carbon on to the rear tip considerably increasing the contact resistance at the forward tip. The other factor was the expansion of the brush surface. The rear tip of the brush was cooled by the air drawn round by the commutator, but the front tip was not so cooled, and the expansion of the contact surface due to heating caused this tip to lift from off the commutator surface and set the brush vibrating. The tip might, however, be kept in proper contact by placing metal foil in close contact with the front of the carbon, and so conveying the heat away.

MR. F. H. WHYSALL said the tendency of the mica to rise had

been got over by reducing it slightly below the surface of the commutator segments. The turbo-generators in use at Dickenson Street were run all day and they had no trouble at all. Their success was largely due to Mr. Hoult.

Mr. F. H. Clough said that if it was dangerous to pass through the critical speed, he agreed with the author that it was necessary to keep the length between the bearings as short as possible, and to use butterfly connections for the armature windings, but if it was possible to pass through the critical speed with safety, it would seem desirable to make the shaft smaller than indicated and so have the running speed well beyond this critical value. The mica might be prevented from becoming displaced by making it slightly wedge-shaped or by suitably roughening the commutator bars.

Mr. R. H. Barbour (communicated):—The commutator is by its very nature unsuited to high peripheral speeds. Its component parts have just the shape which gives them the minimum of resistance to centrifugal force. In a machine having, say, 60 commutator segments, and running at 3,000 r.p.m., each brush has to change from one segment to another 3,000 times in every second. Centrifugal force is continually doing its best to produce unevenness in the height of each one of the 60 segments, and the moment one of them shifts, be it even $\frac{1}{1000}$ in., the fat is in the fire. These considerations render imperative the use of commutators of small diameter, and consequently of long length. In the present turbine machines at least 240 watts are turned into heat per square inch of the contact surface; this is already double what is found best in slow-speed machines, and any further increase is likely to aggravate the present troubles. By adopting the homopolar principle, commutation difficulties are entirely eliminated. Mechanical construction is immensely simplified—slip-rings, if once set true, have no tendency whatever to take up eccentric positions. Even if they are assembled slightly out of truth the forces set up are negligible. Instead of a long thin shaft, a short one may be used, and its effective diameter increased one-third of its length by pressing on a solid steel core, or the core and shaft may be made in one forging. Efficient ventilation of a long commutator is impossible; that of a number of slip-rings is easy, and the use of slip-rings enables more efficient brushes to be used. Cost is reduced by the absence of interpoles and of compensating windings, and the speeds permissible are double those of commutator machines, so that, for a given steam consumption, the cost of the steam turbine is reduced 50 per cent.

Mr. R. Roberts, in reply, said his experience had been that rotors with wire bands retained their original balance better than those with solid rings. The efficiency of the fan that was used in calculating the tables of ventilating losses was 25 per cent. The scheme of cooling the air by sprays of water would scarcely commend itself to a designer until someone else had found it satisfactory; and the greatest objection would be found when starting a cold machine. Water in suspension carried into the machine would then endanger the insulation; but once the machine was warm, this danger would possibly disappear. He agreed that oil throwing was a great trouble, and that oil glands were the only reliable cure; but as the bearings were usually supplied by the turbine builder, this was scarcely in the province of the generator designer. It had been his experience that the shrinkage allowance usually given was far too small, and that 3 to 5 mils per inch diameter was not, as a rule, any too much.

Modern High-Voltage Power Transformers.

By W. T. Taylor.

(Discussion by the Institution of Electrical Engineers *at Birmingham, November 15th,* 1911. *For abstract of the paper see* Electrical Review, *page* 856, *et seq.)*

Dr. C. C. Garrard thought the most valuable part of the paper was that dealing with the installation of transformers, drying out, &c. He disagreed with the author in several of the constructional details mentioned. For example, in describing a core type transformer the author described the core as being held together with linen tape only. This was an unsatisfactory method of construction. The tape must in time give way, and there would be nothing to prevent the laminations bulging out and cutting through the insulation of the coils. Steel bolts should be put right through the laminations, with gun-metal clamping plates on either side. The ends of the bolts should be riveted over, and if they, with the plates, were insulated from the core, no appreciable increased iron loss would result. Coils of all high-voltage transformers should be dried and impregnated by a vacuum process. Equally good results could be obtained with either shell or core type of construction. He preferred the core type owing to its greater simplicity and the ease with which repairs could be carried out. It was often economical to reduce the cross-section of the core and increase that of the yoke owing to securing a lesser mean turn. Also, it often paid to make the shape of the coils of core-type transformers elliptical rather than round, as mentioned by the author, as this resulted in a general saving in weight, and thus reduced material cost. The star-delta connections shown, with the star on the primary side, led to inferior regulation on unbalanced loads. The star-delta connection, with the delta on the primary side, was very good when lighting and power current were both required to be taken from the same transformer. The motors would be supplied from the three phases, and the lighting from phase to neutral. With this system the regulation would not be affected by unbalanced load. The three-transformer method was new to him; he would like to know how it compared in regulation and balancing with the two-transformer method

Mr. Forrest considered that the most troublesome feature in connection with oil-filled transformers was the choking-up of the cooling ducts with oil sludge—a substance resembling soft soap—and the consequent abnormal heating of the transformer due to impaired circulation of the oil. Oil-filled transformers had to be lifted out of their tanks and washed down with oil after they had been in service a year or two, and this was a troublesome and costly process with large units. He thought the forced-oil cooled was the ideal type for large units. The oil was circulated very rapidly by means of a pump, and flowed through the cooling ducts quickly enough to wash them clear of sludge. The hot oil was conveyed through pipes to a cooler (a worm surrounded by water) fixed outside the transformer room, and as the oil was under pressure, if a leak occurred in the pipe or worm, oil escaped, but water could not enter the pipe.

Mr. R. Orsettich said that the troubles usually experienced with all high-tension transformers could be classed under three headings: (1) Trouble with the terminals due to shorts, which sometimes cracked the porcelain. These had been obviated in extra-high-tension sets by the use of the condenser type terminal consisting of a number of concentric tubes. (2) Moving of coils under the strain put on them in switching on and off heavy loads. This was obviated in all the modern types by clamping tightly the core in itself and independently from it the coils, so that no movement was possible either in the portion embedded in the core or in the parts projecting from it. (3) Piercing of the insulation between adjacent turns due to surges. This was obviated by making the insulation on the first coil of the primary connected to the terminals much heavier than on any other coils. Tappings and extra terminals were easily made on transformers of moderate voltage up to 10,000 volts, but became a very serious matter for higher voltages.

Mr. A. M. Taylor pointed out that the paper was written from the point of view of South American experience, where very high voltages were the rule, and breakdowns were much more frequent than in this country. At the Löntsch station in Switzerland, Messrs. Brown, Boveri & Co. had installed three-phase transformers for a 48,500-volt transmission. These transformers were each of 5,250-k.v.a. capacity, for 50 periods. They were water-cooled. Some English transformers of 1,700-k.v.a. capacity, 25 periods, and air-cooled, had now run most successfully for three years in one of the largest English stations. Taking into consideration the value of floor space and the lowness of pressures in this country, they were warranted in installing three-phase transformers in most cases.

Institution of Electrical Engineers.

Yorkshire Local Section.

A meeting was held on November 20th to consider the proposed new Articles. Mr. T. Harding Churton presided, and Messrs. R. Hammond and J. E. Kingsbury, members of Council, were present.

Members unable to attend wrote expressing their dissatisfaction with the proposals to increase the subscriptions, and to give the Council power to raise loans and to incorporate other societies. It was pointed out that provision should be made to enable provincial members to vote without the necessity of attending meetings in London.

Mr. T. Roles said that the proposed increase of subscription appeared to be connected with the purchase of the new building, about which the provincial members had had little to say, as only the usual eight days' notice was given, and the meeting was called when the I.M.E.A. was meeting at Nottingham. He had looked into the question of expenses of the Local Sections, and found that the grant in aid of these, together with travelling expenses, amounted to £729. The number of members within 50 miles' radius of London was 2,397, and their subscriptions amounted to £5,125. Outside that radius there were 3,870 members, of whom 2,550 were in the provinces and 1,320 in the Colonies; the subscriptions of the former amounted to £5,101, and of the latter to £3,004. One-third of the provincial subscriptions (Mr. Hammond's figure) came to £1,700, not £729. There was a discrepancy between the total as reckoned above (£13,000) and that given in the statement of accounts (£11,314), perhaps due to compounding. The grant to the Yorkshire Section was £70, plus £4 7s. 3d. for the printing of papers; the subscriptions came to £509. The *Journal* cost altogether £1,409 net, less than 5s. a head—a paltry sum.

He thought the local members ought to have more say in the business of the Institution, and ought not to be compelled to go to London to vote. The London members had a representation on the Council of 63·3 per cent., while they constituted only 37 per cent. of the membership. The country members did not derive many benefits from their connection with the Institution, compared with those enjoyed by the London members. Of the latter, including Members and Associate Members only, 58 per cent. were Members, while in the provinces only 32 per cent. were Members, and there must be some reason for the difference.

Other speakers endorsed the views of Mr. Roles, and spoke to similar effect. Mr. W. N. Y. King said that they should adhere strictly to electrical science and engineering. Mr. F. W. Cook approved of the adoption of examinations. Mr. W. Emmott said that the present feeling amongst the members was the most healthy sign of activity he had seen in 34 years. Mr. A. B. Mountain suggested that if the Institution wanted money, there were plenty of people willing to take up shares to the amount required.

Mr. W. B. Woodhouse objected to the increase in subscriptions, but said that if it were necessary, it would have to be done. He feared the Institution would become a trading society instead of a

scientific Institution. Mr. S. Clegg thought that many of the Associates would not be able to pass the examination for Associate Membership, and would drop out.

Mr. Hammond pointed out that of 24 Members on the Council, nine were from the provinces. The Institution was not in financial difficulties. It appeared that the members of the Yorkshire Section were not prepared to assist in developing the scope of the Institution if it meant half-a-guinea a year. He defended his estimate that "one-third was expended on the Local Sections," and said that the Council had no desire to raise the subscriptions against the wishes of the members. Anyone in the class of Associates who possessed the technical qualifications would be put in the class of Associate Members.

Mr. Kingsbury said the Council wanted more money to carry out the work of the Institution, and that membership would be more valuable in the future than at present.

Mr. W. Hartnell said the present suggestions came upon them as a thunderbolt. Mr. Schofield and Mr. Laing criticised the new Articles, and a resolution, proposed by Mr. W. Emmott, requesting the Council to defer the question of amending the Articles for a period of 12 months, was put to the meeting (without the consent of the chairman), and carried unanimously.

Dublin Local Section.

A meeting was held on November 14th to consider the new Articles. In deference to the request of the President of the Institution, no resolution was put to the meeting.

The members of Committee raised, point by point, the "opinions" which they had proposed as resolutions at a Committee meeting held on the 13th, and each point so raised was discussed. At the close of the meeting, the members present were invited to sign such opinions as they agreed with, and so well had the Committee gauged the views of the members on vital points, that every opinion was signed by practically every Corporate Member present. One half of the total number of Corporate Members in the Section were present and signed; the signatures obtained next day brought the total percentage of those signing to 60 per cent. of all Corporate Members of the Section. These signed opinions were sent to the Council. We understand that their tendency was adverse to the new Articles of Association.

We have received several lengthy letters on the new Articles, which would occupy many columns if printed *in extenso;* we therefore give the gist of them below:—

Mr. A. H. Dykes:—While he formerly held that members who practised in a consultative capacity should be indicated in some way in the list of Members, he has come to the conclusion that the idea is fallacious, seeing that few consulting engineers confine themselves rigidly to one branch of work, and that there are separate Institutions dealing with Civil, Electrical, Mechanical and other branches of Engineering, each of which would have its own rules for professional conduct. What is wanted is an Association consisting only of practising consulting engineers, and covering all branches of engineering, and he hopes that before the end of the present year such an Association will be actually at work.

If consulting engineering were to be a commercial business, there would be no need for any rules, and any engineer could engage in it, advertise, employ agents, and so on, like a contractor or manufacturer; limited companies, employés of manufacturing firms, and insurance companies could also carry on consulting work. But if it is to be a profession, a code of professional conduct is necessary, and the adoption of such a code by the Institutions of Civil and Electrical Engineers shows that that is their view of the matter. The Association of Consulting Engineers will take these rules as a starting point, and gradually enforce such further regulations as may be considered advisable. At the same time, having accepted such restrictions, they are entitled to corresponding privileges, and as the Institutions have decided that consulting engineers must conform to a different standard to that obtaining in ordinary commercial work, they must support those who undertake to be bound by those restrictions. Such an Association will be of the utmost value, not only to its members, but to the whole body of engineers and the public at large.

Mr. E. W. Cowan: The method of election of its executive is of vital importance to an Institution, quite apart from its effectiveness in selecting the most efficient men. The members should feel that they are governing it themselves, but if the executive is chosen vicariously, they are apt to be apathetic as to their duties and responsibilities and to think only of their rights and privileges—often in a critical and dissatisfied spirit. This attitude is destructive of corporate feeling.

It is clear that the alterations embodied in Articles Nos. 51 and 52 are aimed at strengthening the voice of the general body of the members in the selection of members of Council, &c., but the condition that 25 must support every nomination will not be made use of excepting when there is a feeling of discontent.

I submit that Articles Nos. 51 and 52 be amended to provide:—

1. That a nomination form be circulated amongst the members three months (?) before the election with notification of the vacancies to be filled up, and with an invitation to the members to submit nominations (one month to be allowed).

2. That the results of these nomination votes be tabulated and brought before the Council. The Council then to prepare its own nomination list, endeavouring, in its choice, to interpret, as far as may be consistent with the general interest, the wishes of the members.

3. That one month before the election a paper be circulated amongst the members which will contain two proposal lists—(*a*) a list of the names of those nominated by the members for the vacancies on the Council, together with the number of nomination votes given to each name. Provided that no name be published for which less than 3 per cent. of the total votes recorded has been given. (*b*) A list of the nominations of the Council for the vacancies. This list to constitute the balloting paper, and to be detachable; members to hand in these papers either unaltered, or altered by the substitution of any name or names on the general nomination list.

The above method of election will be recognised as being nearly identical with that adopted by the American Institute of Electrical Engineers, but it is not by any means peculiar to that institution. I have had personal experience of its beneficial working elsewhere.

I do not think that the Council will be out of sympathy with this suggestion, but it rests with the members, now that the constitution is in the melting pot, to express their views plainly and frankly in the proper quarter.

Mr. T. Roles: In the course of the discussion at the meeting of the Yorkshire Local Section I gave certain statistics with a view to showing that the number of country and foreign and Colonial members, as compared with those living near London, is very much greater than is generally realised, and that in view of this fact they should have a much larger share of representation on the Council, and also that it should not be necessary for a member to have to attend a special meeting in London in order to record his vote on a question of vital importance to the Institution, such as the alteration of the Articles of Association.

In order to obtain the figures given in the enclosed statement, the list of officers and members, corrected to August 31st, 1911, has been taken, and for the purposes of this statement all members residing within a radius of 50 miles of London have been regarded as London members, resulting in the inclusion of such towns as Bedford, Brighton, Cambridge, Colchester and Reading, although it is questionable whether the members residing in some of these towns will agree that they are London members.

The Institution of Electrical Engineers.

	London.		Country.		Foreign and Colonial.		Total.*	
	No.	% of total members.	No.	% of total members.	No.	% of total members.	No.	% of total members.
Members ...	568	23·7	391	15·3	369	27·9	1,328	21·2
Assoc. Members	977	40·8	1,209	47·6	603	45·7	2,789	44·6
Associates ...	371	15·4	318	12·3	200	15·2	889	14·1
Students ...	486	20·1	636	24·8	148	11·2	1,270	20·1
Proportion of Members to Assoc. Members... ...	2,402	58 %	2,554	32 %	1,320	61 %	6,276	47 %
Proposed subscriptions ...	£6,689 1		£6,652 5 6		£3,503 6 6		£16,844 13	
Present subscriptions ...	£5,130 12		£5,106 3 0		£1,540 0 0		£11,776 15	
Addition ...	£1,558 9		£1,546 2 6		£1,963 6 6		£5,067 18	

* The totals shown in this column differ slightly from those given in the list of officers and members. This is due to Honorary Members not being included, and the fact that the addresses of a number of members are not given.

	Total.	*Percentage.*
London Members	2,402	38·3
Country, Foreign and Colonial Members ...	3,874	61·7
Representation on Council (excluding Past Presidents).		
London Members	19	63·3
Country Members, including Chairmen of Local Sections	11	36·7

With regard to subscriptions, the total, according to my statement, is £11,776 15s., whereas according to the accounts of the Institution for the year ended December 31st, 1910, only £11,314 19s. 6d. was received. It must, however, be remembered that a number of new members were enrolled between the end of last year and August 31st, 1911; further, that certain members have compounded for their subscriptions, which would account for some discrepancy between the two amounts.

I think the figures given will speak for themselves, and that country members can draw their own deductions, and decide for themselves whether they are being fairly treated as regards representation, voting power, and the amount of their subcriptions provided for under the new Articles of Association.

As the country members' present total annual subscriptions, according to my reckoning as given on the statement, are in the neighbourhood of £5,000, it would appear that the sum expended by the Council on the local sections is very considerably less than one-third of such subscriptions, as stated by Mr. Hammond.

Up to the present country members have been apathetic, and have left the management of the Institution in the hands of a

Council which has been practically self-constituted. I think there is little doubt that such members have not realised their numbers and their power, if the Articles of Association were such as would allow them to exercise it.

The general feeling of all members I have come across in this district is that the present subscriptions are ample considering the meagre advantages obtained by membership, and that if it were possible for the country member to obtain advantages nearly approaching those possessed by members residing in the London district, they would not so much object to the raising of the subscriptions. As far as I can see, the only method of effecting this is for country members to send members to the Council who thoroughly understand and are prepared to express their needs, and the result would be that the position of the Institution would be greatly strengthened in every way.

SILVERTOWN TRAIN LIGHTING SYSTEM.

We recently visited the works of the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., at Silvertown, to inspect a new train lighting equipment which the company has brought out. The apparatus is being made under a patent taken out by Messrs. Anderson, Russell & Gray, and is at present undergoing trials on one of our principal railways; the system has been developed during the past two years at Silvertown, and has been brought to a remarkably high stage of efficiency. Its most noteworthy feature perhaps is its simplicity; the dynamo is quite an ordinary type of machine, the controlling gear is such as has been used for years with satisfactory results, and, in fact, there are no novel or untried devices in the whole equipment. The system, however, is quite new and of a very promising description.

The equipment consists of a dynamo, driven from the coach axle, and carrying on its shaft a governor, which is used to operate the switchgear; and two batteries of accumulators, one of which is normally connected to the terminals of the lamp circuit, whilst the other is connected to the armature terminals, so that it may receive a charge.

The dynamo is of ordinary construction and design, except that the field magnets are differentially wound, one winding being a shunt winding connected by the switchgear to the terminals of the battery which, at any given time, is connected to the lamps (hereafter called the "discharge battery"), whilst the other is a series winding, through which is passed the whole, or a part, of the current supplied by the dynamo to the second battery, called the "charge battery." This winding is connected up by the switchgear so that it opposes the shunt winding, and tends to demagnetise the magnets and weaken the field in which the armature is rotating.

Connected as a shunt across the series winding is a resistance or diverter, which can be adjusted by hand to regulate the proportion of the charging current passing through the series winding, so that if the conditions of working are such that there is an increase in the ampere-hours of discharge from the batteries, the rate of charge of the charge battery can be increased, or if there is a decrease, the rate of charge can be decreased. By so adjusting the diverter resistance that, with any predetermined (nominal) value of the charging current, the proportion of this current passing through the series coils gives a demagnetising effect equal to the magnetising effect of the shunt coils, the charging current can be limited to something *less than* this predetermined value; for, obviously, if the charging current could reach this value, there would be no magnetising force, and the dynamo could not generate an electromotive force, and consequently could not supply any current to the battery. At the same time, as none of the current passing to the lamp circuit passes through the series coils, their demagnetising effect is not dependent on the number of lamps in

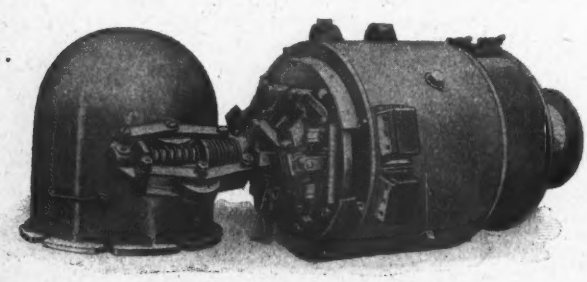


Fig. 1.—Silvertown Train Lighting Dynamo.

circuit, and whether full, half or no lights are on, it is still impossible for the charging current to reach the predetermined value.

The armature shaft carries a centrifugal governor, so arranged that it operates a cut-in switch when the speed of the armature is such that the dynamo, if excited by the shunt coils only, would give a voltage equal to the normal lamp voltage. This cut-in switch first connects the shunt circuit to the discharge battery so as to excite the magnets of the dynamo, and then connects the armature of the dynamo to the charge battery through the demagnetising series coils and the diverter, as well as to the discharge battery and lamp circuit through resistances.

The governor also carries on its collar a projection which, as soon as the armature begins to rotate, engages with a rocking lever, which operates a reversing switch, provided there has been a change in the direction of the rotation of the armature. This collar works against a light spring for the first ½-in. of its movement, so that it is quickly drawn away by the governor when making only a few revolutions per minute, sufficient for the projection to be clear of the rocking lever, thus preventing the

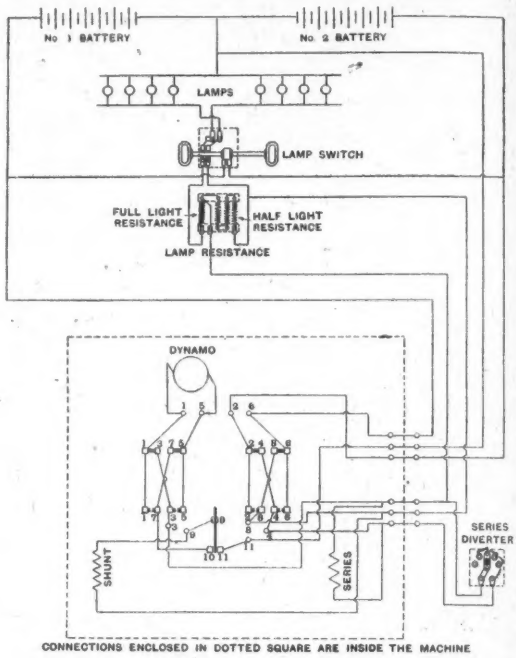


Fig. 2.—Diagram of Connections.

repeated striking of the former against the latter. This reversing switch not only changes the connections between the armature and the batteries so that the dynamo gives current in the proper direction, but also changes the batteries over, so that the one that was the discharge battery becomes the charge battery, and *vice versa*. In addition to the above apparatus, a lamp switch is provided, so that all the lights, or half the lights, can be switched on, and this also couples the two batteries in parallel for charging when all the lights are switched off.

The appearance of the dynamo and controlling gear is shown in fig. 1, and the construction of the governor and switch gear is shown in figs. 3 and 4.

Referring to the diagram of connections, fig. 2, all the connections enclosed in the dotted square are inside the machine. The numbers on the switchboard where a circle is shown denote the points at which the connections pass through the switchboard. The other numbers refer to the reversing and cutting-in and out switches; 9, 10 and 11 are the cutting-in and out switch, and 1, 3, 7, 5 and 2, 4, 8, 6 are the upper contacts, and 1, 7, 3, 5 and 2, 8, 4, 6 the lower contacts of the reversing switch.

If we assume that the train is just starting and all the lamps are switched on, the direction being such that the reversing switch is in the position shown by the full lines (upper contacts), the current will flow through the various circuits in the following manner: from No. 1 battery to upper contacts 6 and 8, to lamp switch and lamps, and back to No. 1 battery. A part of the current will be supplied by No. 2 battery through contacts 2 and 4, through the series winding and its diverter, then through the lamp resistances to the lamps and back to No. 2 battery.

When the speed has been increased sufficiently, the shunt winding will be connected to No. 1 battery to excite the shunt, through contacts 6 and 8 to shunt coils and contacts 9 and 11 back to No. 1 battery, thus ensuring that the voltage is built up before the armature is connected with the batteries and lamps.

Increase of speed will now connect 9 and 11 to 10, and the armature will supply current to the load in the following manner:—The current passes from the armature to contacts 1 and 3, after which it divides, part going through the lamp resistances to the lamps, and part going through the series winding and its diverter and contacts 4 and 2 to No. 2 battery (which is the charge battery when running in this direction). The current from No. 2 battery will now join that from the lamps, and pass through contacts 11, 10, 7 and 5 back to the armature.

If only half the lamps are required, the current will flow as before except that there will be no circuit through one group of lamps, nor through one of the lamp resistances, which were in parallel for full lights. In the event of no lights being used, the two batteries are placed in parallel by the act of switching the lights off. In this case, the current will flow in the following manner: From the armature to contacts 1 and 3, after which it

divides, part going to the series winding and its diverter and part to the "half light" lamp resistance. The current, after passing through the series winding, diverter and lamp resistance in parallel, again divides, passing through both batteries and the shunt winding in parallel, and through contacts 11, 9 and 10 to 7 and 5, and so to the armature.

The system of regulation described above renders it practically impossible to charge the battery at an excessive rate, and provides an easy means of adjusting the amount of charge to the requirements of the battery; the cost of maintenance of the battery should be appreciably reduced, as it will not be necessary to wash it out as frequently, or to replace the plates as soon as in some systems. The dynamo, governor and switchgear are of very simple and robust design and construction, so as to reduce the cost of maintenance, and special attention has been paid to providing easy access to those working parts which require inspection, and to affording facilities for dismantling any parts of the gear when it becomes necessary.

In fig. 3 is given an end view of the switchgear with the governor removed, and a longitudinal section of the governor and switchgear. Fig. 4 illustrates the method of operating the reversing switch, the governor being shown in the position where it is just on the point of changing over the reversing switch from the upper to the lower contacts—a position which, of course, is passed through in a moment, directly the train gets into motion.

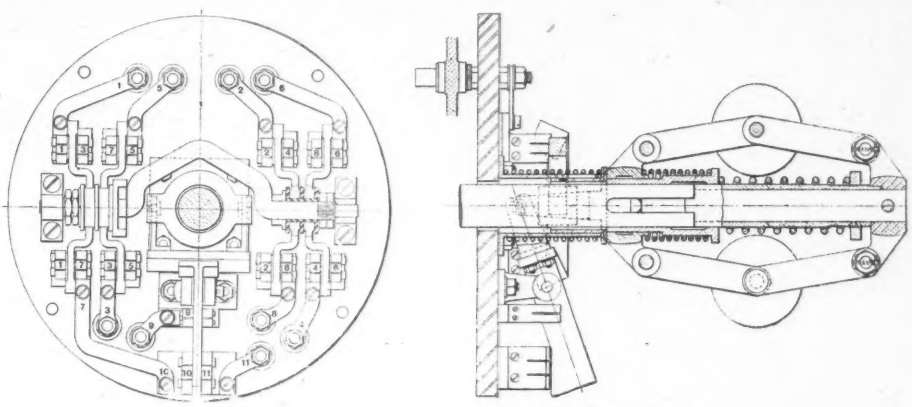


Fig. 3.—Details of Switchgear and Governor.

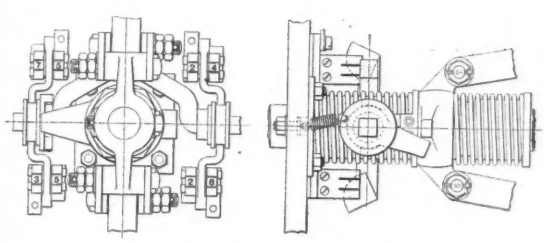


Fig. 4.—Operation of Reversing Switch.

It will be seen that in this system, on a journey in one direction, with the lamps in use, one battery is being charged and the other is either discharging at a low rate, or practically floating, while the dynamo supplies current for both charging and lighting. While the train is standing still, both batteries feed the lamps—one direct, the other through the lamp resistances. The interposition of the latter ensures that the newly charged battery, with its higher voltage, shall not cause the lamps to be over-run. On the return journey, as explained above, the battery connections are interchanged, so that the fully charged battery is now connected to the lamps and the discharged battery is put on charge. Only when the lamps are out of use are the two batteries put directly in parallel and charged together. The voltage on the lamp circuit is remarkably uniform; the greatest variation we observed during a cycle of operations ranged between 23 and 25 volts—about 4 per cent. from the normal—and this only takes place on reversal, that is, at the moment of starting a journey, when a fresh battery is put on to the lamps.

The question may arise whether, if a train were put on a schedule which involved travelling always in one direction by day and returning at night, one battery would be continuously drawn upon to too great an extent. The fact that both batteries would be charged in parallel in the daytime, and that the one which had been in use would naturally take the lion's share of the charge, would go far to remedy this, and the periodical inspection of the equipment that should always be provided for would ensure the detection of any such progressive tendency. Moreover, when the discharge battery is much lower than the other, the latter affords it material assistance when the train is standing with the lights on. These and other points are well illustrated by the test results in the preceding column, supplied to us by the makers.

Speed, R.P.M.	Lamp circuit.		No. 1 battery.		No. 2 battery.		Dynamo amps.	Reading No.
	Volts.	Amps.	Charge amps.	Discharge amps.	Charge amps.	Discharge amps.		
0	23·25	19·0	...	13·0	...	6·0	0	1
440	23·4	19·0	...	12·5	2·0	...	7·5	2
900	24·5	19·3	...	1·75	19·0	...	35·5	3
1,400	24·6	19·4	...	·5	24·5	...	44·0	4
1,480	24·75	19·5	0	0	25·5	...	45·5	5
700	24·25	19·2	...	3·5	15·0	...	30·5	6
1,300	24·75	10·8	...	·5	23·5	...	35·0	7
1,000	24·5	10·6	...	·25	20·5	...	31·0	8
1,490	24·8	10·8	1	...	25·5	...	37·5	9
600	0	0	16·0	0	0	0	16·0	10
900	0	0	20·0	...	11·0	...	31·0	11
1,480	0	0	23·0	...	14·5	...	37·0	12
600	0	0	10·0	...	5·0	...	15·0	13
0	24·5	10·6	...	7·25	...	3·25	0	14

The figures in the table show the voltage at the lamp terminals, and the current in the dynamo, lamp and battery circuits, at different speeds. No. 1 test was taken with the dynamo at rest and all lamps on; Nos. 2 to 6 with dynamo running and all lamps on; Nos. 7 to 9 with half lamps on; Nos. 10 to 13 with all lamps off and batteries charging in parallel, and No. 14 with dynamo at rest and half lamps on. Other figures show that the diverter can be used to vary the maximum charging current over a wide range. In all cases, at a given speed, the charging current is practically the same, whether all the lamps or only half of them are in use.

The system appears to possess many valuable features, and is so simple that there is little chance of anything going wrong. In view of the great desirability of lighting all trains by electricity, we welcome the system and wish it a full measure of success.

A Bavarian Railway Contract.—It is announced that the Bergmann Electricity Enterprises Co., which is a financial subsidiary of the Bergmann electricity works, has secured a contract from the Bavarian Railway Ministry for the electrical equipment of two sections from Garmisch to Mittenwald and from Garmisch to Griesen, the total length of these main lines being 26 miles. Both sections lead to the frontier, and are connected with Austrian railways, the conversion of which is also proposed by Austrian firms. By means of these connections the Garmisch-Mittenwald section would be continued to Innsbruck, and the Garmisch-Griesen section with Vermoos-Fernpass. The success of the Bergmann Co. in obtaining the contract is all the more remarkable inasmuch as Bavaria has hitherto been considered for various reasons to be the special preserve of the Schuckert Electricity Co., of Nuremberg. As far as the transformation of the Austrian sections is concerned, the question arises whether the Austrian Bergmann Co., of Bodenbach, will receive the order for this particular work. Technical considerations are doubtless in favour of this solution of the problem, but it is said that the Austrians are not very favourably disposed towards manufacturing works situated on the frontier, and that they would endeavour to place the contract with Vienna firms, although these are more or less closely associated with German works.

Spanish Hydro-Electric Works.—It is stated that a company has been formed in Barcelona under the title of the Energia Electrica de Catalunya, with the participation of Spanish, French and Swiss financiers. The object is to erect hydro-electric works in the Pyrenees for the transmission of power to Barcelona, where distributing stations are to be established for the supply of energy for lighting and industrial purposes, both in the town of Barcelona and in the province of Catalonia. The share capital has been provisionally fixed at 10,000,000 pesetas, with power to make successive increases according to requirements. At present the company has already commenced the erection of two hydro-electric works, one of which has a fall representing 30,000 H.P. Among the French companies interested in the company is the Compagnie Générale d'Electricité, of Paris, whose chairman is one of the directors of the Spanish company, whilst other directors are representatives of the Madrid General Electricity Co., the Swiss Electrical Industry Co., and the Compagnie d'Electricité, of Marseilles.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

25,211. "Electric reading lamps." R. E. BURNHAM. November 13th.

25,216. "Connecting means for automatic telephone systems." G. A. BETULANDER. (Convention date, November 16th, 1910, Sweden.) November 13th. (Complete.)

25,244. "Electric clocks." W. J. BLENHEIM. November 13th.

25,278. "Wireless telegraphy." J. GARDNER. November 14th.

25,311. "Electric incandescent lamps adapted for motor-cars and the like vehicles and other purposes." F. VON MADALER. November 14th.

25,328. "Process and means for pressing an intensifying screen against a photographic plate in X-ray apparatus." W. OTTO. November 14th. (Complete.)

25,331. "Electric lighting of vehicles." COMPAGNIE INTERNATIONALE D'ELECTRICITE. (Addition to 21,364 of 1911. Convention date, February 1st, 1911, Germany.) November 14th. (Complete).

25,344. "Pole-changer for use in connection with electrical systems of railway signalling." J. P. O'DONNELL and BRITISH PNEUMATIC RAILWAY SIGNAL Co., LTD. (Divided application on 2,887 of 1911, February 4th.) November 14th.

25,345. "Electrically-actuated and controlled apparatus for operating railway semaphore signals." J. P. O'DONNELL and BRITISH PNEUMATIC RAILWAY SIGNAL Co., LTD. (Divided application No. 2,887/1911, February 4th. November 14th.

25,355. "Electric signals." A. C. BROWN. November 14th.

25,364. "Overhead systems for transmitting electricity." J. PAUL. (Addition to No. 28,687/1910. Convention date, November 29th, 1910, France.) November 14th. (Complete.)

25,369. "Process for the magnetic preparation or oiling of ores or the like, and in apparatus therefor." MUREX MAGNETIC Co., LTD., and A. A. LOCKWOOD. November 14th. (Complete.)

25,377. "Couplings for electric mains or wires on railway passenger coaches and other vehicles." J. STONE & Co., LTD., and A. H. DARKER. November 14th.

25,391. "Sparking plugs." H. POWELL. November 15th.

25,416. "Miners' electric safety lamps." H. F. ATHERTON. November 15th. (Complete.)

25,432. "Conduit box for electric switches, wall connections, cut-outs and other purposes." E. H. FENNEMORE. November 15th.

25,446 "Electrical alarm apparatus for cash boxes, jewel boxes and like receptacles." G. DOWNING (trading Henry & Co.) and P. S. MOULTON. November 15th. (Complete.)

25,459. "Electrically driven planing machines and similar reciprocating tools." VICKERS, LTD., and A. D. WILLIAMSON. November 15th.

25,477. "Electrode in the form of a woven fabric for utilising the heating effect and other properties of the electric current." G. JAHR. (Convention date, November 15th, 1910, Germany.) November 15th. (Complete.)

25,488. "Magnetic tachometers." W. P. THOMPSON. (Akt.-Ges. Mix and Genest Telephon und Telegraphenwerke, Germany.) November 15th. (Complete.)

25,489. "Electrical means for producing sound." W. P. THOMPSON. (Akt.-Ges. Mix & Genest Telephon und Telegraphenwerke, Germany.) November 15th. (Complete.)

25,490. "Method for securing the diaphragms in microphone, telephone, gramophone cases and like sound-reproducing apparatus." W. P. THOMPSON, (Akt.-Ges. Mix & Genest Telephon und Telegraphenwerke, Germany.) November 15th. (Complete.)

25 491. "Method for securing the diaphragm in the cases of microphones, telephones, gramophones and like sound-reproducing apparatus." W. P. THOMPSON. (Akt.-Ges. Mix & Genest Telephon und Telegraphenwerke, Germany.) November 15th. (Complete.)

25,517. "Electric-power timber band-saw machines." G. PICKLES. November 16th.

25,518. "Footsteps for telegraph posts or poles and other like posts or poles." BULLERS, LTD., and J. W. JONES. November 16th.

25,528. "Portable miners' electric lamp." T. WOODS. November 16th.

25,529. "Circular accumulator or storage battery." A. L. GLADWELL. November 16th.

25,558. "Electrical signalling devices." C. E. MAYER. November 16th.

25,562. "Infantry field telephone heel plate earth connection." E. N. F. HITCHINS. November 16th.

25,564. "Lampholders and other electrical connectors." W. J. BADMAN and F. KEEPING. November 16th.

25,580. "Electrolysis of fused salts and anodes therefor." E. A. ASHCROFT. November 16th.

25,586. "Regulating devices for three-phase current arc lamps." A. HEIMANN and W. SCHAFFER. (Convention date, November 17th, 1910, Germany.) November 16th. (Complete.)

25,616. "Electrical magnetic switch." G. NIXEY, jun., and L. MARTIN. November 17th.

25,649. "Ornamenting incandescent electric lamps." MC I. J. D. CARTER. November 17th.

25,669. "Dynamo-electric generators and motors." H. K. WHITEHORN. November 17th.

25,672. "Insulation of electrical conductors, coils or the like." SPECIALFABRIK FUR ALUMINIUM-SPULEN UND LEITUNGEN G m.b.H. (Convention date, November 21st, 1910, Germany.) November 17th.

25,683. "Method and apparatus for localising faults in cables and circuits." J. H. J. A. STEPHENSON. (Convention date, November 17th, 1910, Germany.) November 17th. (Complete.)

25,707. "Secondary batteries or accumulators." W. CLARK. (V. de Karavodine, France.) November 17th.

25,718. "Improvements in wireless telephony, applicable also to wireless telegraphy." H. G. MATTHEWS. November 17th.

25,743. "Electrical switch gear." B. THOMAS and E. THOMAS. November 18th.

25,756. "Electric light fittings for attachment to musical instruments and music holders." P. R. J. WILLIS. (J. G. Mackenzie, Canada.) November 18th.

25,776. "Safety devices for electrical installations." W. DIERMAN. (Convention date, August 22nd, 1911, France.) November 18th. (Complete.)

25,785. "Conversion of single-phase into polyphase alternating currents." J. K. CATTERSON-SMITH. November 18th.

25,797. "Electromagnetic device for moving points to be operated from moving vehicles." R. D. HUNT. November 18th.

25,813. "High efficiency electric incandescent lamp and holder." J. S. BANAJEE. November 18th.

25,814. "Electric dynamo and alternator and current distributing systems." J. S. BANAJEE. November 18th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

COOLING OF DYNAMOS AND THE LIKE. G. H. Fawcus. 25,036. October 26th. (April 28th, 1911.)

AUTOMATIC TELEPHONE SYSTEMS. W. Wanisch. 25,243. October 31st.

METHOD OF AND THE MEANS FOR THE ELECTRIC LIGHTING OF PICTURES, WORKS OF ART AND THE LIKE. S. W. Maddick. 25,371. November 1st.

CEILING ROSES AND LIKE ELECTRICAL FITTINGS. E. I. Parkes. 25,478. November 2nd.

VARIABLE-SPEED SELF-REGULATING DYNAMO-ELECTRIC MACHINES. C. A. Vandervell and H. H. Midgley. 25,588. November 3rd. (Applications Nos. 29,493 of 1910 and 2,158 of 1911.)

ELECTRIC HORNS. G. E. Tate. 25,858. November 7th.

ELECTRICALLY-DRIVEN DRILLING APPARATUS. Justice, P. N. (Soc. Anon. Electricité et Electro-Mecanique.) 27,701. November 28th.

CONSTRUCTION OF ROTARY ELECTRIC SWITCH SPECIALLY APPLICABLE FOR CONTROLLING THE ELECTRIC LAMPS OF MOTOR-CARS. A. A. Price. 28,501. December 7th.

SUSPENSION APPARATUS FOR ELECTRIC ARC LAMPS AND OTHER PURPOSES. H. Smithson and Sharpe. 29,314. December 16th.

1911.

METHOD FOR REDUCING THE LOSS OF ENERGY IN LINES WITH VARIABLE ELECTROMAGNETIC EQUALISING. F. A. Becker. 65. January 2nd. (January 4th, 1910.)

GALVANIC SOCKS. A. W. Boston. 233. January 4th.

JOINT FOR EARTHENWARE OR STONEWARE TROUGHING FOR ELECTRIC CABLES AND THE LIKE. R. Shuttleworth. 2,765. February 3rd.

MEANS FOR SUPPORTING ELECTRIC INCANDESCENT LAMPS AND OTHER ARTICLES. G. A. Phillips and H. M. Phillips. 3,526. February 11th.

ELECTRIC MOTORS. W. R. Macdonald. 4,286. February 20th.

AUTOMATIC OR SEMI-AUTOMATIC TELEPHONE EXCHANGE CIRCUITS. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 7,852. March 29th.

MAGNETIC SPEED-INDICATORS AND THE LIKE. W. K. Menns. 9,575. April 19th.

METHOD OF PRODUCING DISK-LIKE ELECTRIC FLAMING ARCS FOR CARRYING OUT GAS REACTIONS. Electrochemische Werke Ges. and Rothe. 13,385. June 2nd. (July 8th, 1910.)

SYSTEMS OF ELECTRIC LIGHTING. S. W. Rushmore. 14,478. June 19th.

PROCESS FOR THE ELECTROLYTIC PRODUCTION OF AMMONIUM NITRATE FROM HYDRATED NITRIC ACID. Elektrochemische Werke Ges. 16,426. July 17th. (July 16th, 1910.)

ELECTRIC PLUG COUPLINGS. F. Clapham. 16,935. July 24th.

FLEXIBLE ELECTRIC CONDUCTORS. E. V. Cheese. 17,387. July 31st.

ARC LAMP ELECTRODES. British Thomson-Houston Co. (General Electric Co.) 17,723. August 3rd.

Siberian Trade.—Our contemporary, *The Engineer*, is calling attention to the mistake British engineers are making in neglecting Siberia. "All reports appear to indicate that our hold over that country is getting worse and worse, whilst our most active trade rivals, America and Germany, are leaving no effort untried which may improve their position. . . . It is sufficiently obvious from the energy with which others are exploiting the market that it is worth making an effort to recover at least some of the ground we have lost. An exceptional opportunity offers itself at present, for the present Governor-General of the Pri-Amur is much more progressive than his predecessors, and appears to be making efforts . . . . to encourage commercial and industrial progress. Indeed, it is clear that a new policy has been awakened, and that the great natural resources of Eastern Siberia are to be developed. Railways and shipping are being encouraged, whilst public works are projected, and inducements are being held out to agriculturists to settle in the district. All this means an increase of the very market that Britain can supply, and it will be a matter for supreme regret if she allows the opportunity to escape her. Her indifference to the Omsk Exhibition has already been the subject of comment in these columns; we hope to have a different tale to tell of the Khabarovsk Exhibition of 1913. If more glory is to be got from the great popular exhibitions of Europe and American, more solid value is to be won at such exhibitions as Omsk and Khabarovsk, which, being in a more or less inaccessible part of the world, appeal less to the general public, and are therefore more thoroughly devoted to the object of encouraging trade." Our contemporary suggests that the Board of Trade should pay particular attention to the Exhibition in question, and endeavour to encourage British manufacturers to take a more active interest in a country full of possibilities.

Charge Dismissed.—Frank Woods, electrician, 1A, Lee Crescent, Portobello, was charged at the Dunfermline Police Court last week, with having stolen, from the Townhill Colliery, 90 lb. of copper wire and 17 lb. of rubber insulation. Woods stated that he had been employed by the Admiralty and on the *Mauretania* and *Lusitania*, and it was contended for the defence that it was a custom of the trade that electricians got the clippings as a perquisite. The Magistrate dismissed accused with an admonition, remarking that he was willing to believe that Woods was under the impression he had a right to do what he had done. At a later sitting of the Court, a dealer who had purchased the material, claiming he had paid the full price, applied for its restoration to him. The Magistrate, however, pointed out that he had made an order for the return of the goods to the colliery owners.